EDITORIAL

A SPANISH toreador, who was recently killed while engaged in his calling, left a fortune of $1,600,000 all amassed in nine years. He fared better than some of our acquaintances, who have tried to make a living by throwing the bull.

SHIPS now under construction throughout the world will have a capacity when completed of 7,941,000 gross tons, compared with 3,343,000 gross tons under construction in March 1914, which was probably a fair average for pre-war times. The ships now on the ways, when they are placed in commission, will more than make up for the total loss of shipping during the War, but not enough to provide for the increase that would have normally taken place during the past six years if the world had been at peace.

YOUNG men who have been urged to obtain a thorough technical education as a preparation for their life-work will be encouraged to do so when they hear that we recently received a letter from the United States Civil Service Commission containing announcements of two examinations, one for mining draftsman at $1200 per year and one for acetylene welder at $1500 per year. It is also stated that appointees to either position may if satisfactory receive the temporary increase allowed by Congress of $20 per month.

A STEEL concern second in size only to the United States Steel Corporation has recently been formed in Canada under the name of the British Empire Steel Corporation, which has an authorized capital of $500,000,000 and which includes companies controlling coal and iron mines, steel mills, foundries, forge-plants, shipyards, and other metal-working concerns. That the new corporation will probably not confine itself to Canada is shown by the fact that men prominent in the Australian and Indian steel industries are represented on the directorate.

MOVING-pictures are still considered by most people as being merely a nearly universal and relatively inexpensive form of amusement. Such a viewpoint loses sight entirely of the fact that they constitute a most effective means of 'putting an idea across' to the general public. As a possible means of education, the motion picture can supplement the press and can be used in fields that cannot be reached at all by either the school or the church. It is unfortunate that the power of the 'movie', like the power of the press, is so frequently misused. On the other hand a group of leading manufacturers, educators, and business men generally have recently formed the 'American Service League', with offices at 20 West 45th street, New York, whose object is to produce and distribute high-grade films teaching Americanism, and dealing mainly with the lives of builders of the Republic. This is a step in the right direction.

MEDDLING with technical matters about which they are incompletely informed is a favorite pastime with State legislatures, but it is seldom that such a course reacts so quickly as has happened in Oregon. At the last regular session, the legislature of that State enacted a law fixing a limit of 56° Baume for gasoline, and prohibiting the sale of any gasoline of lower gravity within the State. Protests from the oil companies were in vain, it was too good a chance for the legislators to make themselves solid with their automobile-driving constituents and at the same time to bait 'certain rich corporations'. The effect of the law was bad from the start, but its foolishness did not become plain to everyone until recently. As most of our readers know, gasoline of any grade is scarce enough now, and to supply the people of Oregon with the kind required by the State law has become utterly impracticable. Consumers simply could not get gasoline, that was all there was to it. So now State officials by general agreement are winking at violations of the law, while certain large consumers are offering to pay the entire cost of convening the legislature to repeal it.

STRIKES lasting as long as the present one call a number of things to the attention, which, were conditions normal, would never be noticed. Have you ever thought of the foreman who has remained on the job, for instance the man who has had charge of a shop for ten or fifteen years. In that time he has trained many men and boys, boys who have come to him entirely without training and who have developed into capable mechanics under his guidance. These boys have developed along with the foreman, men have come into the shop and found the foreman a real man and have learned his ways, the whole force are following the lead of a man in whom both employer and employee have absolute confidence, the first that he will get his money's worth and the second that he will get fair treatment. The general knowledge of a foreman of a large shop, either manufacturing or jobbing, is something to be admired and respected. How many realize that, in these days when the skilled mechanic is on strike, the foreman must use from his fund of knowledge things that he learned as an apprentice, lay out jobs that he has not had to touch for years, take green hands and show them how to run machines, which were but yesterday operated by machinists. How many men of the modern school of foremen can do what some of these men are now doing? We'll say they are some he-men.

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The Foreign Trade Convention

Since 1915 it has not been San Francisco's fortune to entertain such a large body of able and influential men as those that assembled for the Foreign Trade Convention last month. Among the many interesting addresses delivered, the opening speech by Mr. James A. Farrell, Mr. William C. Redfield's discussion of future American trade with Russia, Mr. A. C. Bedford's address on petroleum, and Mr. Eugene P. Thomas' demonstration that the only effective way to build up foreign trade is to encourage imports, were perhaps the most notable. The resolutions adopted at the Convention called among other things for the immediate ratification of a peace treaty, return of control of the American merchant marine to private hands, reorganization of the diplomatic and consular service together with increase of both the number of commercial attaches and of their compensation, increase of facilities for education in foreign trade, and development of internal waterways as a help to the perfection of foreign trade routes.

The Shipyard Strike

The first outward sign since the commencement of the shipyard strike on October 1 last of weakening on the part of the strikers came when the Bay Cities Metal Trades Council suggested that the question of returning to work be referred to the individual unions affected. Following this announcement, two unions, the carpenters and the joiners, voted on May 21 to return to work. At the present writing, none of the other unions affected have followed their example, and some of the officials of these unions have declared that the members will not return to work except on their own terms. A recently published official list of members of the California Metal Trades Association indicates that, while nearly all the larger concerns retain their membership, many of the smaller ones have resigned, presumably in order to sign agreements with the unions. Violence and intimidation of workers in the yards and shops continues, and doubtless keeps some men from going to work for members of the Association. Nevertheless, the labor difficulties of the local yards and shops are little more than an aggravated form of the labor shortage characteristic of practically every industry at the present time. In fact, it is possible that the final closing of the strike would have less effect upon the industrial situation than is generally expected.

Drives

If everyone did just as they should, those interested in a worthy cause would find it necessary merely to announce the financial needs of that cause to the public and the necessary funds would be forthcoming. Human nature being as it is, however, such a method would not get results, and something more effective is necessary. From the days of Dick Turpin down, authorities have recognized that personal solicitation is far ahead of any other method of raising money. It remained, however, for the emergencies of the War to systematize this method and to bring it to its highest development. Those of us who participated in many of the great 'drives' will remember how apologetic we felt in the earlier drives at going around and asking strangers for money, and how in the later campaigns, the shoe was very definitely on the other foot, and those who failed to contribute, or who gave a relatively small amount, felt called upon to apologize. In fact, among the few good things accomplished by the War was the 'getting across' in a considerable degree to the average American citizen that his money is not unrestrictedly his own, but is to be used for the public good, and that he should give earnest consideration to every worthy cause in order to determine whether or not he should contribute. That this lesson may not be forgotten, if for no other reason, 'drives' along the same general lines as those occurring during the War should continue to be held. But, after the above mentioned earnest consideration, each citizen should feel at liberty to give or not to give, to give little or to give much, without outside coercion of any kind. Is this the case with 'drives' as they are conducted at present? It is not. The various methods of coercion, direct or indirect, that are used, do not need to be described. Our readers know them all too well. This sort of thing defeats its own purpose since people soon get into the habit of giving only enough to ensure freedom from molestation, and ultimately may even become so disgusted with the whole system as not to give at all. There is an old superstition with a foundation in fact that money obtained dishonestly brings bad luck to its possessor. Something of the same kind is likely to prove true of charity funds obtained by some of the strong-arm methods now in use.

Rodgers Abandons Shipyard

After having recently taken over the 'Skinner & Eddy No. 2' shipyard from the United States Shipping Board, Mr. David Rodgers abandoned the yard on May 12 and the Shipping Board, without formally accepting the yard back again, placed its men in charge. Inability to finance the contracts for the ships that he had arranged to construct is given by Mr. Rodgers in a public statement as the reason for the abandonment. This statement virtually attributes his difficulties in financing the project to opposition to his supposed intention to operate on a closed-shop basis. In support of this contention he quotes from a letter supposed to have been written by some unknown Seattle correspondent to Judge E. H. Gary, suggesting that influence should be brought to bear on Mr. Rodgers by the Steel Corporation to persuade him to run his yard open-shop. The directors of the Associated Industries of Seattle, which organization is trying to establish the open-shop or 'American Plan', immediately issued a statement denying knowledge of

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this letter or of sympathy with any effort to bring influence to bear on Mr. Rodgers. At this writing Judge Gary has made no public statement either regarding the receipt of such a letter, or as to what action the Steel Corporation would be likely to take on a request of this kind. In Seattle business circles, however, Mr. Rodgers' failure to finance his operations is attributed not to his closed-shop inclinations but to the terms of his contracts with the ship-owners and of his agreement with the Shipping Board. His principal contract was for five tank-steamers, with a probable doubling of the order, having a capacity of 8400 tons each at a price of approximately $190 per ton. This amount, shipbuilders declare, is too low at the present prices of labor and material. In fact Mr. D. E. Skinner, president of the Skinner & Eddy Corporation, has declared that his company will not build freighters for less than $200 per ton nor tank-steamers for less than $225. Furthermore, the terms of Mr. Rodgers' agreement with the Shipping Board are said to have been disadvantageous, providing as they did for a payment of $600,000 during the first year and a total payment of $3,400,000 in five years. Mr. Rodgers deserves great credit, not only for his achievements in shipbuilding during the War, but also for his vigorous though unsuccessful efforts to get shipbuilding going again in Seattle. Apparently, however, he allowed his enthusiasm to outstrip his business judgment, and entered into agreements so disadvantageous to him as to raise doubts regarding successful performance.

Entering 'The Presence'

Why is it that the average man, as soon as he acquires a private office, begins to feel that he must take other means of separating himself from the vulgar public? You go up to the dragoness in the outer office and ask for Mr. Smith. "Whatsyername?" says the dragoness. You give it. "Haveyeranappointment?" You sadly confess such is not the case. "Whadjerwishtosehimabout?" With difficulty you select words to describe your mission and also adapted to the mentality of the dragoness. If in her judgment, you do not look like a 'live one', the statement "Mistusmithsout" usually closes the interview. Perhaps instead she communicates with the Holy of Holies and reports that Mr. Smith is 'in conference', which may mean a great many things, but usually either one of two. Either he is sitting in his own or another office, telling an associate about his golf score or automobile trip of last Sunday, while that associate waits open-mouthed for a chance to get in a word edgewise about his golf score or automobile trip, or else he has his feet on the desk in his own office alternating between 'setting and thinking' and 'just setting'. Perhaps, however, the great man is reported as 'engaged at present', and you wait for a couple of hours, only to be informed finally that "Mr. Smith is very sorry, but he cannot see you today. Perhaps if you come in tomorrow at four o'clock, he can spare you a few minutes." When you come in at four the next day, you find that Mr. Smith has left for the day. Or perhaps the great man rushes out of his office with an expression that would be vacant if it were not so forbidding and forbidding if it were not so vacant, and tries to get rid of you as soon as possible by conversing with you at the main counter in the presence of two office-boys, a stenographer, and three other callers. Now, we submit that all this kind of thing is pure unadulterated Bunk, which, instead of showing the importance of the man trying it, merely exposes his incompetence. We feel particularly sure of this because there are concerns that make no use of the above-mentioned Bunk. In particular, we have in mind one company employing thousands of men. Anyone with a real reason for seeing any official of that company can feel sure of getting an interview reasonably soon, an interview, moreover, in that official's private office, and one in which he receives that official's courteous and undivided attention. How do they do it? We do not know, but if they can do so, any other company could. Probably, one reason is that sufficient clerical and other minor help is employed, so that the executives do not have to occupy themselves with unnecessary detail. But more important yet, we believe, is that courteous treatment of the public is a tradition of the company. By the way, the company's stock is far above par.

The Bonus, And Who Will Pay It

Having the Government hand you something, must, we are sure, be very pleasant, although for ourselves, we have never had anything so handed, except a few tax-bills. Even the prospect of receiving real money in that way is exciting, to say the least. Consequently, we do not greatly blame certain men formerly in the United States Army because of their advocacy of an indiscriminate bonus, particularly when we remember that so many of those who were able to stay at home 'got theirs while the getting was good'. Nevertheless, we believe that the proposed flat bonus applying to all the military forces (except, mind you, the Regular Army which is left out in the cold) is not justified and would be disastrous to the country as a whole. The men who have suffered wounds or impairment of health because of being in the service, must be restored to health as far as possible and, if they are unable to resume their old occupations, they must be re-trained. There has been a good deal of muckraking regarding this work, but we believe that the authorities having it in charge are equal to the task of completing it. Probably more money is needed than was originally anticipated, and such amounts as can be shown to be needed should and will be appropriated without question. There is also a relatively small class of former service men who, either because of special financial sacrifices made to enter the service, or for similar reasons, need assistance in getting on their feet again. The Nation should be just and even generous to these men also. But the granting of a bonus to all former

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service-men, most of whom are just as well or better off both physically and financially than if they had never been in the Army, is another matter, while the very size of the amount involved makes all previous raids on the Treasury seem small by comparison. Estimates of the amount required range from $1,500,000,000 to $2,000,000,000, or about half the total national debt at the close of the Civil War. This tremendous sum cannot be squeezed from the regular revenue. It must be provided either by a bond issue or by increased taxation. If bonds are to be floated at par, they must bear 5½% or 6% interest, and the issuance of such bonds would depress the price of the outstanding issues still further. The other horn of the dilemma, increased taxation, is not any more attractive. Federal taxation has already reached a point where it is throttling legitimate industry. Further increases might easily be disastrous. Perhaps the most absurd plan for raising the money is the plan soberly suggested in Congress for a tax upon war profits. This is retroactive legislation with a vengeance. 'Where are the profits of yesteryear?' Gone probably to make up this year's deficit, or if not, either distributed among and spent by stockholders or else transformed into capital and returned to the business. In any case, such a tax must in effect be a burden upon this year's business, and may easily be confiscatory in its nature. Furthermore, whatever method may be adopted to obtain the money needed for the bonus, the effect must necessarily be again to increase the cost of living, which is high enough as it is. The unlimited bonus ought to be defeated.

What are We Going to do for Gasoline?

The above question might well be amended to read 'gasoline, fuel oil, and other petroleum products'. Although the total production of petroleum for the entire country is exceeding all previous records, consumption is even greater, and stocks are being reduced. The situation on the Pacific Coast is even worse. In spite of every effort to increase production, the rate of output remains less than in 1914, when the demand was much lower. As a result, stocks here have nearly reached the vanishing point. In certain districts, usually those at a distance from centres of production, actual shortages have developed. For instance, vessels have experienced so much difficulty in obtaining fuel-oil in the North-West, that ship-owners are considering a return to coal-burning equipment.

All this is a source of worry to those directly interested, and ought to be a matter of concern to us all, although it is not. But gasoline, as Abe Potash would say, 'is something else again'. It is a curious fact that whether or not he owns an automobile or any other gasoline-engine, the man in the street feels greater interest in gasoline than in almost any other commodity. When he is unable to get all he wants at the service-station around the corner, he feels as if the foundations of the civilized world were cracking.

The present situation has been aggravated by the railroad strike, which has interfered with shipments, but could not have been averted anyway. The heavy demand for gasoline begins in April and continues through September. Last year, for instance, the oil companies started the season with large quantities of gasoline in storage, and were therefore able to supply all comers. This year, because of increased demand, stocks were small when the spring demand commenced. For several weeks past, distributors in many country towns have had to limit the amounts supplied to their customers. The result has been that producers of food, who actually required the gasoline to take care of their crops, when they came to San Francisco to consult with oil-company officials, were treated to the spectacle of thousands of joy-riders wasting the fuel so sorely needed. Such a condition was intolerable and could not be allowed to continue. The curtailment of sales to pleasure-cars in the Bay district was the only logical course. The tractor, the truck, and the gas pumping-engine must have precedence over the less-essential pleasure-car. Some degree of shortage is likely to continue throughout the summer. If owners of pleasure-cars are sensible and do not use their machines unnecessarily, there will be enough gasoline for everybody. Insofar as they fail to do this, they increase the danger of strict rationing, with little, if any, gasoline allowed for pleasure-riding.

Just as there is no reason to get excited about conditions this year, so there is no occasion for alarm for the future. It is true that the number of automobiles and other gas-engines is increasing much faster than the output of petroleum, but it is also true that refining efficiency has increased so that a larger proportion of the crude oil is recovered as gasoline and high-grade distillates, and on the other hand, that engine-design has advanced so that much lower-grade distillates can be used. It is true that, in the past, the producer was wasteful just as the consumer still is, but the higher prices that cured the producer of wastefulness will ultimately do the same thing for the consumer. With the passage of time it becomes more and more evident that the stock of any of our natural resources is insufficient to permit waste, but the time when any of them will become too scarce for beneficial use is certainly a long way off, and may never come at all.

Prohibition of export, the favorite cure-all proposed by the 'little Americans' in the Senate and elsewhere, would have little effect on domestic supply or price. The amount of Californian petroleum and distillates exported to foreign countries is growing less each year, and will become almost negligible when old contracts now in force have expired. At the present time, one of the principal companies is importing twice as much as it is exporting, and would import even more if it could be obtained. The other companies are similarly situated.

So don't use your car unnecessarily; don't waste gasoline at any time; and don't blame the man at the service-station or the company for which he works on account of conditions beyond their control.

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The Rolling Mill of the Columbia Steel Company

FIRST SHIPMENT MADE FROM THE NEW MILL

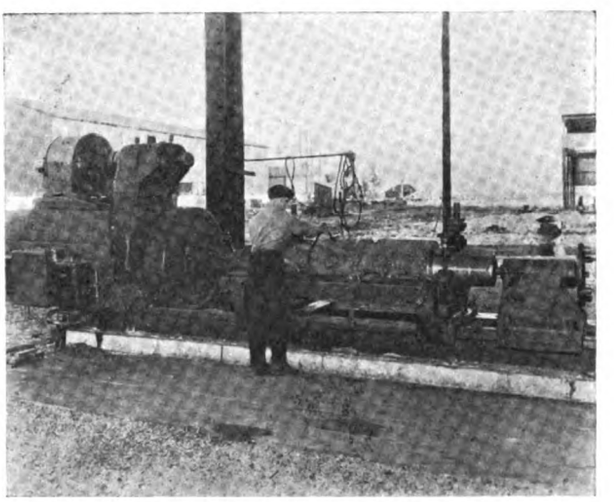
The new 18-in. merchant-bar mill of the Columbia Steel Co. at Pittsburg, California, commenced rolling operations on March 29, 1920. This mill embodies the latest developments in rolling practice, being designed especially for efficient and economical production. At the present time it is used for breaking down 8 by 8 in. billets, which are later finished into bars on the 12-in. Belgian mill. Ultimately the 18-in. mill will be used for finishing large rounds, squares, and light shapes, all of which material will be rolled directly from the ingot.

The 18-inch mill has four roll-stands, three of which are 3-roll high, the other being a 2-roll stand. It is driven by an 800-hp. General Electric alternating-current, slip-ring type, heavy-duty rolling-mill motor. The switchboard control for this motor is automatic and of the latest type. The power is transmitted through a Falk gear-reduction set having a ratio of three to one. The speed of the mill is 85 r.p.m. The fly-wheel weighs about twenty-two tons. The mill is equipped with outboard bearings and enclosed pinions.

Mechanical tilting-tables handle the material on each side of the mill. These tables are operated electrically and use direct current. The large generator-set necessary for converting alternating to direct current is placed near the switchboard equipment for the 18-in. mill.

The 12-in. Belgian mill is a five-stand mill, similar in type and make to the 18-in. mill already described. It is driven by a 450-hp. motor with a Falk reduction-gear. The fly-wheel weighs about ten tons. The mill speed is 210 r.p.m. This mill commenced operation April 5. It is served by an independent 18-in. single-stand 3-roll roughing-mill. This mill breaks down the billets as they come from the billet-furnace, a conveyor delivering the billets directly to the mill. It is driven by a 450-hp. motor with a Falk reduction-gear. The fly-wheel weighs about 15 tons. The speed of the mill is about 100 r.p.m. Mechanical tables are now being built which not only permit handling the material mechanically through this particular mill, but will also deliver the semi-finished bars to the 12-in. mill.

The 18-in. merchant-mill is served by an oil-fired pusher-type continuous furnace, 94 ft. long, with a capacity of 103 eight-inch square ingots, each weighing about 900 lb. The 12-in. mill is served by a similar furnace used for heating billets, a conveyor delivering the hot billets from the shear. The billets are fed into the furnace by a mechanical pusher. This not only saves labor but ensures uniform heating of the billets in the furnace.



LATHE FOR MACHINING ROLLS

The cooling-beds are 240 ft. long and are equipped with conveyors at the top, which deliver the hot bars from the mill, and another set of conveyors at the bottom, which deliver the cooled bars to the finishing-shears at the end of the bed in the storage and shipping building. The bed has a pitch of 7% between the upper and lower conveyors. From the shears the bars are counted

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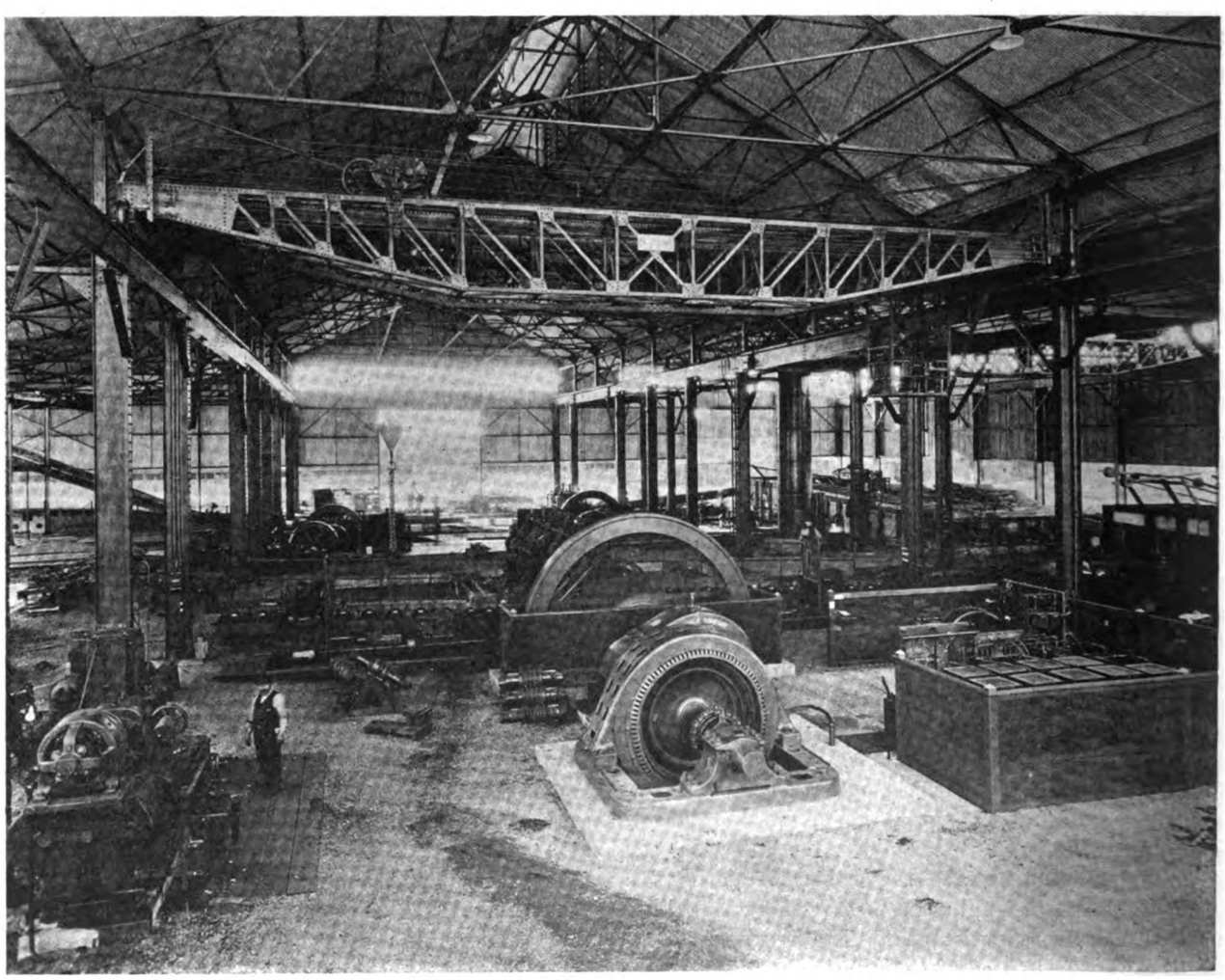
and checked, and picked up by a ten-ton overhead traveling crane and weighed, ready either for shipment or to be deposited in the storage building. The racks in this building have a capacity of about 10,000 tons of finished material.

The three mills were built by the United Engineering & Foundry Co., which also furnished the large roll-lathe in the mill building. The three reduction-gear sets were furnished by the Falk Co. The fly-wheels were furnished by the Joshua Hendy Iron Works of San Francisco. The motors, switchboards, transformers, and other electric apparatus were furnished by the General Electric Co. The overhead traveling cranes, of which there are three, one in the billet-building, of 5-ton capacity, one in the mill-building, and one in the storage-building, each of the latter having a capacity of ten tons, were furnished by the Cyclops Iron Works. A view of the furnace-bay is given on the opposite page, while in the centre, the cooling-bed, and below the 12-in. mill are shown.

The buildings, which were fabricated and erected by Dyer Brothers of San Francisco, are of the 'V'-roof type of structural steel, covered with galvanized corrugated iron. They are all light and airy, with high roofs. The crane-clearance is not less than 28 ft. in any of the buildings. The dimensions of the buildings are as follows: billet-building, 60 by 200 ft.; mill-building, 60 by 220 ft.; leanto from mill-building, 40 by 200 ft.; two cooling-bed buildings, at right angles to the above, each 40 by 230 ft.; shipping and storage building, 80 by 220 feet.

A notable feature of the mill is the extent of the precautions taken for the safety of employees. All gearing is solidly enclosed. Motors, transformers, and fly-wheels are screened with heavy wire-screening. Steps and platforms are built to allow easy accessibility from one side of the mill to the other. In fact, nothing has been left undone in providing the best mechanical safeguards throughout the plant.

Another notable feature of the mill is the lay-out, which permits the steel to travel practically in a straight line from the ingot to the finished bar in the storage warehouse. This is in accordance with modern routing systems in large manufacturing plants and is an important factor in obtaining large and economical production. The mills ran without interruption from the start, and the first month's operations showed an average output of about 100 tons per eight-hour shift. At the present time all of the mills are being operated on a two-shift basis.



ROLLING-MILL BAY, 18-IN. MILL IN FOREGROUND, 12-IN. MILL IN REAR

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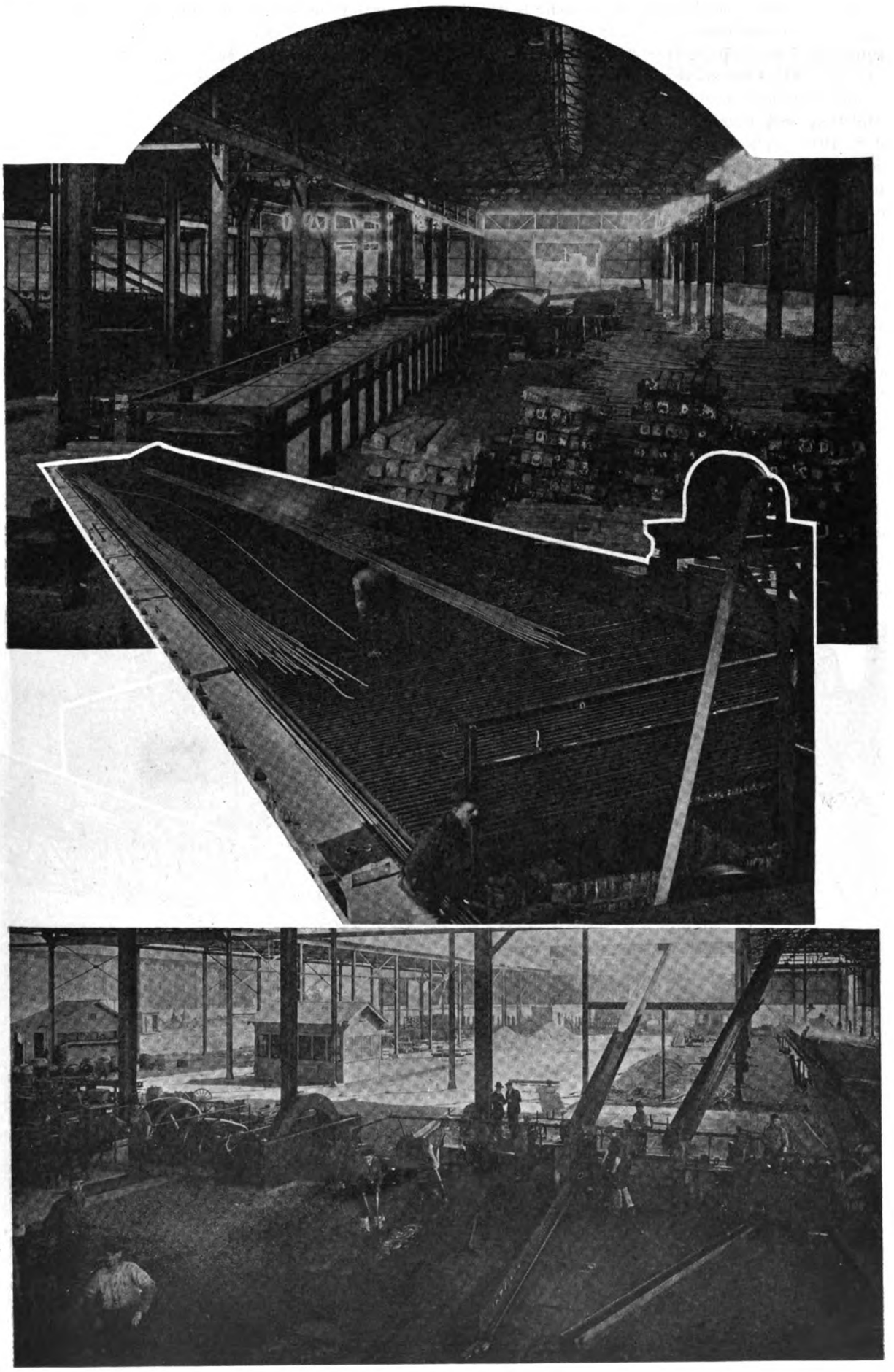

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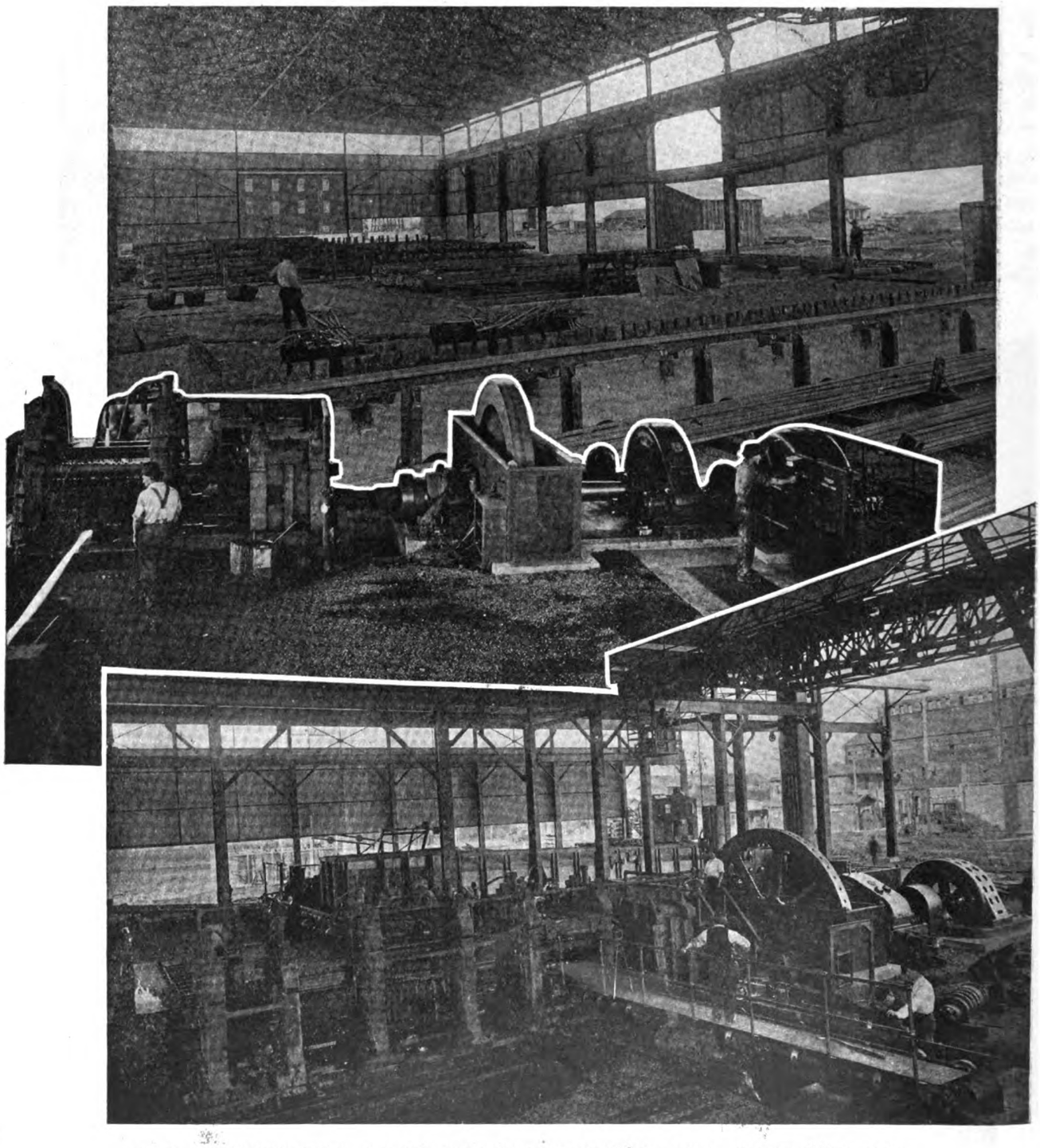
The material that is being rolled at present is as follows: square deformed bars for reinforcing, $\frac{3}{8}$ to $1\frac{1}{4}$ in.; plain square and round bars, from $\frac{1}{2}$ to $1\frac{1}{2}$ in.; rivet-rod, from $\frac{5}{8}$ in. up. All of the above material can be furnished to meet any standard specifications.

Ground was broken for the building foundations on August 8, 1919. The energy with which building operations were carried on is indicated by the commencement of rolling on March 29, as already mentioned, in spite of delays caused by the steel, coal, and railroad strikes.

Material for export is shipped by lighters from the company's docks, and is delivered alongside of steamers in the San Francisco bay. Two transcontinental railroads, the Santa Fe and the Southern Pacific, and the San Francisco & Sacramento Electric Railway as well, offer facilities for rapid and efficient transportation. The Columbia Steel Co. also operates the largest steel foundry west of the Rocky Mountains. The present capacity of the plant, which is equipped with open-hearth furnaces, is about 7000 tons per month. Castings weighing as much as 56,000 lb. have been made there.



ABOVE, STORAGE-BUILDING. CENTRE, ROUGHING UNIT OF 12-IN. MILL. BELOW, 18-IN. MILL

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Speeds, Feeds, and Depth of Cut in Grinding*

Although specific recommendations regarding speeds and feeds cannot be laid down for grinding in the same way as is possible for work done with cutting tools, some general rules can be given. The proper speed for the grinding-wheel depends upon its own strength of particles and bonds, the size of its grain, the kind of material being ground, and the amount of force exerted by the operator when hand-grinding, or the depth of cut or amount of work done when machine-grinding.

In cylindrical or flat grinding, the speed of the work and work-table are the limiting factors as regards the amount that can be done per minute, whatever the wheel and whatever its speed. So that within the range of grades in wheels that is known today, and the range of speeds of table and work on the machine, and the variety of materials being ground, we can vary the speed of the wheel within wide limits, and still accomplish the same amount of work.

For instance, a surface-speed of 6000 ft. per minute of wheel is used commonly on cylindrical grinding-machines, but on a successful surface-grinding machine, a surface speed of 4000 ft. per minute is removing an equal amount of material in the same time as is removed frequently on the cylindrical grinding-machine with the wheel running at 6000 ft. per minute. With surface-grinding, the arc of contact is so much greater than in cylindrical grinding that a softer wheel must be used and at a slower speed in order to prevent the wheel from burning. Speeds as low as 2000 ft. per minute have been used with success on certain kinds of surface-grinding work.

Revolving the wheel at all would not be necessary if it were possible (which it is not) to obtain grains of grinding material and a bond of sufficient strength. The work could then be passed against the grains and they would act just as the planer-tool does. Since such strength of particles and bond cannot be obtained, the wheel must be revolved in order to distribute the work over many particles. Therefore, the softer or weaker the wheel, the faster it must revolve in order to prevent its being worn away too rapidly, and the harder and stronger the wheel, the slower it may revolve without undue wear.

Different kinds of material being ground cause the wheel to act differently, and accordingly make it necessary to vary the speed of the work, the speed of the wheel, or the grain and grade of the wheel. Within reasonable limits, the grain and grade are relatively unimportant, since the speed can usually be adjusted to compensate for such variation. In grinding different kinds of material, different grades of wheels can be used, providing the wheel-speed corresponds with the particular kind of material being ground and the grain of the wheel.

Varying the work-speeds used makes it possible to secure a wider range of wheel-service than could be obtained by varying the wheel-speed alone. Satisfactory and nearly uniform results are secured with wheel-speeds ranging from 2000 to 5500 ft. per minute. It is sometimes necessary to change the number of revolutions per minute of the wheel so that when a large wheel has been worn down, the surface-speed can be brought back more nearly to the maximum. However, the most recent investigations indicate that the most efficient wheel for standard cylindrical grinding is one in which the hole is of such a size that the number of revolutions can be kept constant for a surface-speed of 6000 ft. per minute with a new wheel and 4000 ft. per minute when it is nearly worn out.

Grinding-machines are usually not provided with means for varying the speed of the wheel-spindle because the same object can be obtained at much less expense and in a simpler way by varying the work-speed. Furthermore, a given range of work-speeds produces a wider range of effect than a much greater range of wheel-spindle could give. For instance to obtain the same range of effect by varying spindle-speeds as could be obtained by varying the work-speed between 20 and 138 revolutions per minute, it would be necessary to vary the spindle-speed between 169 and 1233 revolutions per minute. For a wheel 17 in. diam., the higher speed would give a surface-speed of 6400 ft. per minute, which is the highest speed considered safe, while the lower speed would give a surface-speed of 890 ft. per minute, which is so slow that the wheel would wear away rapidly and become useless, provided the grade was soft enough to be effective at the 6400-ft. speed.

When the work-speed has been adjusted to obtain the best results, care should be exercised to maintain a constant revolution of the wheel with no slippage of belts, or momentary slowing because of lack of power. When the speed is irregular, minute particles of the material being ground adhere to the wheel-face, which causes the wheel to cut less freely, delaying production and calling for more power as well. Machines should not continue in operation with insufficient and irregular power.

Determination of the proper rate to feed the wheel into the work is something that in the main must be left to the judgment of the operator, who must learn from experience. The rate of feeding must, however, be constant, or the varying strain upon the grain-particles will cause them to become loosened, and they will fly off the wheel before they are actually worn out. In addition, this breaks up the wheel-face unevenly, and the wheel requires truing much sooner than if the feeding had been done properly.

*Based mainly upon 'Little Known Facts About Grinding', issued by the Norton Co., Worcester, Massachusetts.

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Although there are some classes of work where rapid production can be obtained only by taking deep cuts, as a rule, the greatest production is obtained when using the maximum width of wheel-face that a given machine will carry, at the same time using the maximum traverse of the work so that the face of the wheel will cover the work being ground with the largest number of cutting particles per minute. For example, the most economical way of grinding soft steel is with a relatively deep cut and a soft wheel, whereas in order to produce an equal amount of work in grinding a chilled-iron casting it would be necessary to take a lighter cut and to cover a greater amount of material being ground by means of a wider wheel, thereby removing an equal amount of material in the same time. The reason is that the wheel would not stand deep cuts in chilled iron. In general, the greater the number of cutting particles coming in contact with the work in a given time, the less the depth of cut necessary for given amount of material removed.

For certain operations, wheels 6, 7, and even 10 in. wide are used. To get the best results and the maximum work when using these wide wheels, the work should be traversed the entire width of the face of the wheel at each revolution of the work. This applies only to the kind of work that has to be stroked while grinding. For work that is accomplished by the straight-in cut, the face of the wheel must be slightly wider than the surface being ground.

The following general rules as laid down by Professor Alden are applicable:

1. Other factors remaining constant, increase of work-speed increases grain-depth of cut, and makes a wheel appear softer.

2. Similarly, a decrease of wheel-speed increases grain-depth of cut.

3. Similarly, diminishing the diameter of the grinding-wheel increases the grain-depth of cut, and increasing the diameter of the wheel decreases grain-depth of cut.

4. Similarly, making the diameter of work smaller increases grain-depth of cut. Conversely, making the diameter of the work larger makes the grain-depth of cut smaller.

The Universal Grinding Machine Co. recommends a surface work-speed for steel of 15 to 25 ft. per minute for ordinary work, although on a hard and tough steel, better results will be obtained with slower speed for roughing. For finish-grinding the speed should be increased. For cast-iron, surface work-speeds from 25 to 35 ft. per minute will usually give the best results. A higher speed can be used for finishing than for roughing.

The Universal company recommends that the traverse-speed of the work for roughing steel should be about two-thirds of the width of the wheel per revolution of the work, and slightly less than that for cast-iron. For finishing, the traverse per revolution should be narrow. It will be noted that these recommendations are not in exact agreement with those of the Norton Co., as given above.

United States Chamber of Commerce Adopts Resolutions

As solutions of many of the country's industrial and social problems the Chamber of Commerce of the United States at its eighth annual meeting advocated increased production and economy in expenditure. Joseph H. Defrees, of Chicago, formerly vice-president and chairman of the executive committee of the Chamber, and at one time president of the Chicago Association of Commerce, was named to head the institution in the place of Homer L. Ferguson who retired after a one-year term.

The resolutions of the meeting, which was called an 'Increased Production Convention', include the following:

A treaty of peace should be put into effect without further delay.

The Government should refrain from entering any field of business that can be conducted by private enterprise.

Railroad transportation facilities should be improved.

Congress should expedite shipping legislation as the means of giving the country a merchant marine.

Pivotal industries should be protected.

The War Department should delay no longer in making final disposition of war plants and machinery.

A national budget should be adopted.

A general cash bonus given to all men who served in the War without any discrimination should not be given.

Provision should be made for supplying populations with the necessaries of life in emergencies.

Agricultural organizations, as being an integral part of business, should be taken into the Chamber.

Far Eastern Importers and Dealers in Machinery

Supplementing report No. FE-128, Market for Industrial Machinery in Far Eastern Tropics, the Bureau of Foreign and Domestic Commerce has compiled lists of importers of and dealers in machinery for each country, giving addresses, and, so far as practicable, the kinds of machinery carried. They should prove of interest in view of the development in the Orient along many lines that make imperative the employment of kinds of machinery never before known in those localities, as well as an increasing demand for the types already introduced. In many instances the trade goes to those who have established connections with the dealers or importers, as the possibility of the early fulfilment of orders is a factor to be taken into consideration. These lists may be obtained for the separate countries by referring to the corresponding list numbers as follows: Australia, FE-23010; British Malaya, FE-18005; Ceylon, FE-22007; Dutch East Indies, FE-19007; Hawaiian Islands, FE-26003; India, FE-21012; Japan, FE-11013; Manchuria, FE-14008; New Zealand, FE-24006; Philippine Islands, FE-25003; Hongkong, FE-15001; and China, FE-13009.

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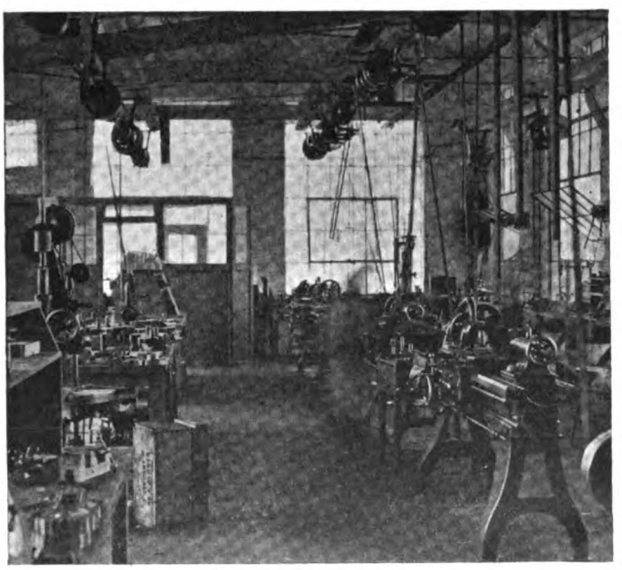
Marchant Factory Reconstructed Following Fire

Following the fire of last November, which practically gutted the interior of the main building at its plant, the Marchant Calculating Machine Co., of Emeryville, im-

MAIN MACHINE-SHOP

mediately set to work to reconstruct its factory. An account both of the fire and of the methods used to salvage the machine-tools and other equipment damaged by the

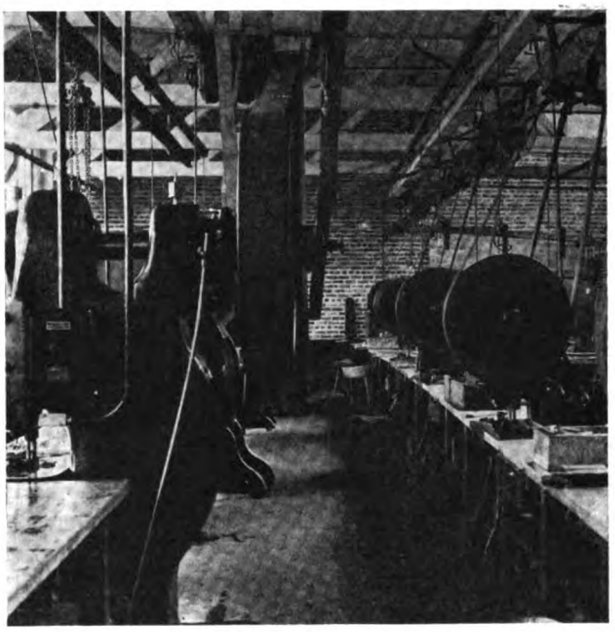


TOOL-ROOM

fire appeared in 'Metal Trades' for February. So vigorously was the work of reconstruction pursued that the factory was back on production in 60 days after the fire.

Re-building the plant has included not only the repair of the fire damage but also the making of several improvements, some of which are for the purpose of providing increased fire-protection while others relate to better lay-out and similar changes, the need for these having been shown by the experience since the plant was originally erected. The completion of these improvements has been delayed somewhat by the necessity of making them without interfering with the regular factory operations, as the unavoidable though relatively short shut-down following the fire had put the factory far behind in its deliveries. The work is now, however, practically complete.

The most important changes from a fire-prevention standpoint were the construction of several brick fire-walls, 12 in. thick, with tin-clad fire-doors, and the pro-



PUNCH-PRESS SHOP. NOTE FIRE-WALL IN REAR

vision of a sprinkler system. In the main building a fire-wall separates the principal machine-shop from the departments where are situated the punch-presses and the grinding, buffing, and plating department. Fire-walls also separate two wings from the main building, one containing the store-room and the tool-room and the other the assembling department. Adjoining the store-room is a fireproof concrete vault 32 by 36 ft. for the storage of dies and fixtures. The entire building, including the two wings, is protected by a sprinkler system installed by the Automatic Sprinkler Co. of America. This is supplied from a 20,000 gal. tank, from which two mains run down each side of the main building with branches to the wings. The mains are 6 in. diam. at the tank, decreasing in size toward the end of the building. The sprinkler-heads are placed approximately 9 ft.

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centre to centre in one direction and 10 ft. centre to centre in the other. The sprinkler-heads open when a temperature of 165°F. is reached. Approximately a 60% reduction in the insurance rate is obtained for a building of the general characteristics of the Marchant factory because of the installation of the sprinkler system.

Market for Iron and Steel in Burma

According to Lawrence P. Briggs, consul at Rangoon, about $5,000,000 worth of iron and steel products, not including hardware and machinery, are imported into Burma per year. The principal items are sheets, plates, and oil-country pipe and tubing. Most of the plates used are plain. Galvanized and tinned sheets are used to a great extent in the construction of buildings. Petroleum is one of the principal products of Burma, and large quantities of casing and tubing have been used for the 1500 oil-wells in the country. There is also several hundred miles of line-pipe in oil-transportation lines. Most of the skilled employees in the industry are Americans, and this is one of the reasons why most of the oil-field machinery and equipment, including cable, is imported from the United States. Other articles that are mainly supplied from America are nails, screws, rivets, washers, and all kinds of structural steel.

Importers of iron and steel products into Burma may be grouped into three or four general classes: (1) The large users, shipbuilders and oil-well and mining firms, usually buy through their own agents in England or the United States. (2) The large special importers and retailers are generally British concerns, with headquarters in England or Scotland, where purchases are generally made. (3) Contractors and builders usually import on their own account wherever they can buy to the best advantage, but during the past few years they have been compelled to buy in the bazaars. (4) The bazaar dealers are generally Indians, and buy wherever they can do so to the best advantage.

HENRY had come home after being at college three months. And he was a changed young man from the village youngster that had been sent away. He had that know-everything air, a patronizing manner toward the whole family, and a bit of black fringe on his upper lip which he was wont to caress affectionately and call a 'mustache'.

Now that black fringe worried grandmother more than anything else. She complained to grandfather as she lovingly eyed his flowing white beard. "Just to think that your beautiful beard originated from such an insignificant mustache as Henry has now," she deplored.

Back came a retort from grandfather, who was also being much patronized by his grandson. "Worse still," he groaned, "my brain was once just as meagre as his now is."—'Indianapolis News.'

Storeroom at the Marchant Plant

In the store-room at the factory of the Marchant Calculating Machine Co. of Emeryville, recently completed following the fire that damaged the plant last November, there are a number of interesting features. The manufacture of calculating machines calls for keeping a large

FIG. 1. DRAWERS FOR STORING SMALL PARTS

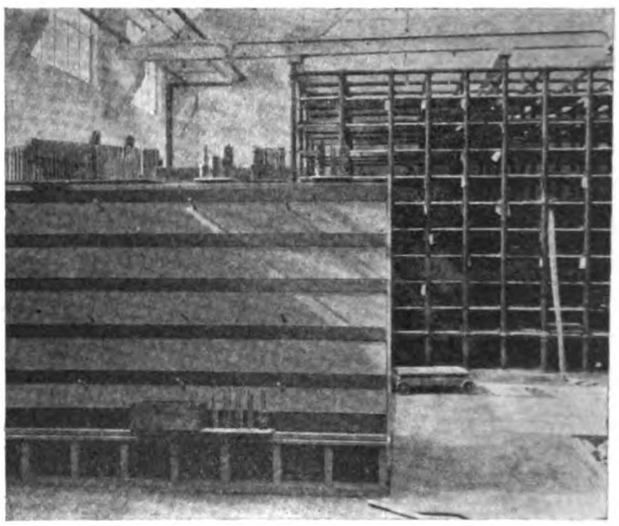

FIG. 2. PART OF STOREROOM

variety of small parts. For most of these the relatively inexpensive drawers shown in Fig. 1 are used. These are 'home-made' of inch lumber, are 5 by 10 by 16 in. inside measurement, and have a small angle-iron fastened to each of the lower edges. These angles run on a slightly larger angle fastened to the racks as shown in the figure. Even a well-loaded drawer slides in and out of the rack without much effort. The racks at the right of Fig. 2 are of metal, and are used for flats, strips, rods, and tubing of both steel and brass. On the left provision is made for storing machinery steel on the pegs shown. The method of handling the small wheels used in large quantities in the calculating machine is also shown in Fig. 2.

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Electric Furnaces in the State of Washington

Bulletin No. 5 of the Engineering Experiment Station of the University of Washington, 'Electro-Metallurgical and Electro-Chemical Industry in the State of Washington', by Charles Denham Grier, contains the following data regarding electric furnaces in Washington at the time of the preparation of the bulletin, March 1919.

There are nine electric steel-furnaces in operation in steel foundries in the State. The largest is the six-ton Greaves-Etchells furnace installed at the Bremerton Navy Yard. Two companies have two furnaces each; the remaining five are in separate establishments. With one exception all the furnaces are acid-lined, and, of course, do no refining, the operations consisting simply of melting steel scrap. Four different types are used: the Girod, the Greene, the Rennerfelt, and the Greaves-Etchells.

The features common to all are a shallow hearth, sidewalls, and an arch, of suitable refractory materials, the whole enclosed in a boiler-plate shell and mounted on trunnions, rollers, or rails so as to be capable of being tipped. One or more electrodes enter the furnace through the roof. They are held in position by external supports fastened to the shell. A suitable tapping-spout and door and also one or more charging-doors are provided.

There are two Girod type furnaces at the Washington Iron Works; the larger, a three-ton furnace, was built by the Girod Co.; the smaller, which has a capacity of one ton, by the Washington Iron Works.

The three-ton furnace is basic-lined with a mixture of California and Washington magnesite, with a silica-brick arch. It is the only furnace in the State in which refining is done. A single electrode enters the furnace through a water-cooled ring in the arch. The other connection is made from a water-cooled plate at the bottom of the furnace by means of steel rods through the magnesite hearth; the latter arrangement is the distinguishing feature of the Girod furnace. The electrode is screwed to a bronze water-cooled electrode-holder, which is fastened to a cross-piece which moves vertically between two upright guides fastened to the sides of the shell. The position of the electrode is controlled by an automatic regulator. The furnace is tipped by means of a hydraulic device.

The small furnace is acid-lined and the electrode is hand-regulated. The electrode-holder grips the electrode from the side and permits the use of threaded connections. In this way the electrode is all utilized; there are no butt-ends wasted as with the larger furnace. Amorphous-carbon electrodes are used in both furnaces and are said to give better satisfaction than graphite ones.

The Greene furnaces were designed and installed by

Name of Company	Location of Plant	Nature of Process	Equipment	Installed Capacity
Washington Iron Works	Seattle	Steel melting and refining for castings	1 3-ton, basic-lined, single-phase, Girod steel furnace	800 kva.
		Steel melting for castings	1 1-ton, acid-lined, single-phase, Girod steel furnace (made at the plant)	800 kva.
Olympia Steel Works	Seattle	Steel melting for castings	1 2½-ton, acid-lined, two-phase, Greene steel furnace	700 kva. (2-400 kva. transformers, Scott connected)
		Steel melting for castings	1 ¾-ton, acid-lined, single-phase, Greene steel furnace	300 kva.
Aurora Foundry Co	Seattle	Steel melting for castings	1 1½-ton, acid-lined, single-phase, Greene steel furnace	800 kva.
Pacific Car and Foundry Co	Renton	Steel melting for castings	1 1½-ton, acid-liner, two-phase, Greene steel furnace	440 kva. (2-250 kva. transformers, Scott connected)
Skagit Steel and Iron Co	Sedro-Woolley	Steel melting for castings	1 ¾-ton, acid-lined, two-phase, Rennerfelt steel furnace	330 kva. (4-100 kva. transformers, Scott connected)
Puget Sound Navy Yard	Bremerton	Steel melting for castings	1 6-ton, Greaves-Etchells steel furnace	1200 kva.
Everett Steel Co	Everett	Steel melting for castings	1 ¾-ton, acid-lined, two-phase, Greene steel furnace	300 kva.
Capitol City Iron Works	Olympia	Steel melting for castings (Not yet in operation)	1 1½-ton, acid-lined, two-phase, Greene steel furnace	440 kva. (2-250 kva. transformers, Scott connected)
Lamb Machine Co	Hoquiam	Steel melting for castings (Being installed)	1 1½-ton, acid-lined, three-phase, Greene steel furnace	500 kva.
Rothert Process Steel Co	Seattle (Georgetown)	Production of tool steel from ore	Special three-phase furnace, similar to Greaves-Etchells steel furnace	525 kva.
Bilrowe Alloys Co	Tacoma	Ferromanganese production	6 2-ton, open top, Girod ore furnace type furnaces. Hearth graphite carbon and tar mixture; magnesite side; fire brick top	2280 kva.
Seattle Smelting Co	Seattle (Van Asselt)	Ferromanganese production (Not now in operation)	1 2-ton, circular, open top, three-phase furnace. Conducting bottom is one electrode, two others are suspended from above	450 kva.
Tacoma Smelting Co	Tacoma	Electrolytic copper refining	3 Standard, multiple cell tank houses. Capacity, 204 million pounds of copper per year	3000 kw.*
American Nitrogen Products Co	La Grande	Production of sodium-nitrite by fixation of nitrogen of the air	Wielgolaski furnaces	3000 kw.†

* Estimated. † Average power used.

ELECTRIC FURNACES IN WASHINGTON IN MARCH 1919

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A. E. Greene, a Seattle engineer. The shape of all the Greene furnaces (with the exception of the three-quarter-ton furnace at the Olympic Steel Works, and the furnace at the Pacific Car & Foundry Co.'s plant, which are more nearly of the proportions of the Girod type furnaces) is that of a cylinder with a horizontal axis and with spherical segments at the ends. One or more carbon or graphite electrodes enter the furnace at the top through water-cooled rings, and a bottom electrode, consisting of a water-cooled steel plug, extending through the hearth from the shell to the bath. The furnaces are tipped for pouring by rolling the shell on rails by means of a hydraulic device. The single-phase furnaces have a single upper electrode and the hearth-electrode. The two-phase furnaces have two upper electrodes connected to the phase busses of a two-phase, three-wire system, and the hearth electrode to the common bus. The electrode regulation is by hand.

There is a three-quarter-ton Rennerfelt furnace at the plant of the Skagit Steel & Iron Co. at Sedro Woolley. The peculiar feature of this furnace is the use of three electrodes, two of which enter the furnace from the sides at a small angle from the horizontal, whereas the third is vertical. The two side-electrodes are connected to two legs of a two-phase power supply and the vertical one to the neutral. An interesting feature of this furnace is the use of carborundum bricks for the roof.

The Greaves-Etchells furnace at the Bremerton Navy Yard employs three-phase power. There are two upper electrodes and the hearth lining acts as the third electrode.

The rate for power for electric furnaces quoted at the present time by the public-service corporation serving Seattle is 1.5c. per kilowatt-hour. There are, however, old contracts still in force at lower rates. One old schedule for twenty-hour, off-peak operation was at the rate of 0.5c. per kilowatt-hour, and the schedule which superseded this provides for a minimum rate of 1.0c. per kilowatt-hour if the load-factor for the month does not fall below 43%. These rates are comparatively high, the amount of power consumed is small, and the furnaces are used merely as a convenient method of obtaining molten steel for casting. They were erected to supply a local demand, which absorbs nearly all of their production. Similar furnaces could be operated equally or nearly as well in almost any other locality furnishing a market, and the successful operation of the furnaces is not because of the availability of cheap power, but rather because of the demand for the product and the availability of the scrap steel, which is the raw material used by the various companies.

At the smelter of the Tacoma Smelting Co., just outside of Tacoma, there is a refinery for treating the copper produced there, consisting of three tank-houses each equipped according to standard practice for multiple refining. The yearly capacity is said to be 204,000,000 pounds.

The Rothert Process Steel Co. of Seattle is producing high-carbon steel from magnetite ore brought from British Columbia. This is accomplished by reduction of the ore with charcoal in a furnace resembling a Greaves-Etchells steel-furnace. The furnace has a shallow magnesite hearth and a silica-brick roof. There are two vertical upper electrodes extending through the roof, and embedded in the hearth is an iron plate, which, when the hearth becomes heated, acts as the third electrode. The furnace has a holding capacity of two tons of steel. The transformer equipment consists of three 175-kva. transformers connected in delta to give a low-tension current of 100 volts.

The details of the operation are kept secret, and little can be said except that, apparently, good high-carbon steel is being made in small quantities (not over a ton a day when operating). The steel is poured into split cylindrical ingot-molds, and the ingots are forged under steam-hammers into bars of convenient size for the uses intended, usually tool-making. The control of the carbon content is said to be accomplished easily, as well as of the other metalloids. The ore is said to be especially pure, and the forging into bars must have a good effect on the physical characteristics of the steel.

The only ferro-manganese plant in the State in operation at the present time is that of the Bilrowe Alloys Co. at Tacoma. In this plant, manganese ores from Philipsburg, Montana, are mixed with sufficient coke for reduction, limestone for fluxing, and a little metallic iron, and then smelted in six single-phase open-top shaft furnaces. Each furnace has a capacity of a little less than two tons per day when operating on the best ores. Four of these furnaces are enclosed in shells of $\frac{3}{16}$-in. boiler-plate, 77 in. diam., 69 in. high, flanged at the top, with a 6-in. strip of brass running from top to bottom to break the magnetic circuit. The shells are cooled by a water spray from a perforated pipe that encircles the shell near the top. The other two furnaces are of reinforced concrete, $7\frac{1}{2}$ ft. square on the outside with a circular central shaft 79 in. diam. The lining of both kinds of furnaces is the same. At the bottom is a water-cooled cast-iron grid, which is embedded in and under the rammed mixture of ground carbon, graphite, and coal-tar that forms the bottom of the crucible. The side-walls of the crucible are made of California magnesite and extend up above the smelting-zone. Above this, the lining is of hard-burned firebrick, which will best withstand the abrasive action of the charge and of the poking necessary to ensure proper descent of the charge.

The two concrete furnaces each have a guide, which extends from the sides and across the top of the furnace to hold the electrode in the centre of the shaft. The other furnaces lack this feature, and their electrodes are merely supported by steel cables from a car-truck overhead. In all except one furnace, 16-in. square, amorphous carbon electrodes are used; in that one 20-in. round electrodes of the same material are used. The electrodes have threaded recesses in each end and new lengths are joined to the electrode in place by means of a threaded plug screwing into both pieces. A paste of graphite and raw linseed oil is used between the surfaces to increase the conductivity of the joint. Putting on a new length requires from ten to fifteen minutes with the

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concrete furnaces, but from one to two hours on the other furnaces.

The electrode-holders are in two parts, which clamp on the sides of the electrodes. They are water-cooled. The flexible water-connection required is an asbestos ½-in. steam-hose. These holders have arms that extend past the side of the furnace where the clamps which make connections with the leads are bolted on. A counterweight balances this eccentric weight. Some trouble has been experienced with the holders, as the electrode faces are irregular and good contacts are not made over the entire surface. This results in hot spots, which eat away the carbon, sometimes producing an arc that attacks the copper, and frequently allows the electrode to drop.

The power required for each furnace is approximately 350 kilowatts. The current is supplied to the terminals of the furnace at about 55 volts. The power factor is said to be about 90%. The conductors to the furnace, which are ¼ by 6-in. bars, are placed close to each other to minimize reactions, and the magnetic circuit in the shell is opened by the strip of brass mentioned before. The energy required per long ton of product is said to vary between 4600 kilowatt-hours, which is the amount used when running on the best ores, to an average of 5500 kilowatt-hours, which was the figure obtained over a period of four months while using the different grades of ore shown below. Power is purchased at rates varying with the load factor, and this is usually such as to earn a rate of from 3.31 to 3.52 mills per kilowatt-hour. Under the power contract, the plant is subject to shut-down in case of low water. During the past two years it has lost approximately ten days together with three or four minor interruptions.

The following analyses represent the different grades of Montana ore used:

	Mn	SiO_2	P	Fe	Al_2O_3	Moisture
	%	%	%	%	%	%
Concentrate	49.13	9.4	0.081	1.0	2.7	10.3
Washed ore	42.07	20.2	0.092	1.3	4.0	12.2
Coarse good ore	47.08	15.08	0.055	1.2	3.0	5.81
Coarse poor ore	38.27	23.4	0.077	..	6.0	9.55

The concentrate is fine and tends to pack in the furnace so tightly that the gases formed by the furnace reactions cannot pass freely. The result is that gas accumulates until the pressure is high enough to force a passage, which is usually along the electrodes, through which it 'blows' with considerable force, materially shortening the life of the electrode. To minimize this trouble, coarse ore is mixed with the concentrate in equal quantities. It is also found necessary to mix the ores so that the Al_2O_3 content does not exceed 4%. Ores exceeding this amount yield a slag which does not separate well from the metal, which is entangled in, and clings to, the slag when cool.

Typical analyses of the ferro-manganese and the slag produced are as follows:

Ferro-Manganese	%
Manganese	80.03
Iron	11.5
Silicon	0.6
Phosphorus	0.274

Slag	%
Manganese	13.97
Ferrous oxide	1.2
Silica	34.7
Lime	35.8
Alumina	4.6

The ingredients of the charge are bedded in small bins and are mixed by shoveling into the charge-cars which carry it to the furnace. The furnaces are fed continuously and are kept poked down at all times except during the 20 minutes before tapping. It is desirable to have the furnace crust over before tapping so that no imperfectly separated material will be tapped out. The ferro-manganese and slag are tapped into shallow cars every two hours, allowed to cool for several hours, after which slag and metal separate along a clean line if the charge has been correctly proportioned.

The Seattle Smelting Co. formerly operated a single ferro-manganese furnace. This is a circular firebrick shaft 8 ft. diam., and 8 ft. high. Six ¼ by 3-in. iron bands bind the furnace together. The internal diameter is 5½ ft. The hearth bottom is made of a mixture of ground carbon and tar. Embedded under the hearth is a water-cooled iron plate which is attached to one of the three leads from the transformers. The other leads are connected by flexible copper strips to the cast-iron electrode-holders, which grip two electrodes suspended vertically in the shaft of the furnace. Three-phase power is supplied to the furnace at 55 volts by transformers of 450 kva. capacity. The furnace produces about two tons per day when operating favorably. The power-rate was based on a sliding scale involving the load-factor; the minimum was one cent per kilowatt-hour.

The plant was erected to take advantage of the high prices of ferro-manganese prevailing in the summer and fall of 1917. Its operations were hampered by lack of regular supply of electrodes, ore, and coke, and by the high cost of power. As a result of these difficulties, together with its small capacity and the drop in the price of ferro-manganese, operations were discontinued in May 1918.

The operations of the American Nitrogen Products Co. at Lagrande, are veiled in secrecy. The main facts are as follows: Furnaces of the Wielgolaski type oxidize the nitrogen of the air and the resultant gases are neutralized under proper conditions to form sodium nitrate. A little nitrite is unavoidably produced. Secondary power is purchased at the Lagrande power-house of the Tacoma municipal system at the rate of $10 per kilowatt-year. This low rate is made to dispose of power otherwise wasted, and because of the disadvantage to the nitrate plant of the fact that it can obtain power only when there is a surplus over the other demands on the generating system. So far the plant has lost completely three weeks in the fall and one week in the winter, and each day, except Sunday, it has to be run at half capacity for ten hours.

The operations have been successful on account of the high price of sodium nitrate caused by the great demand for this reagent in the new American dye industry. The company has the benefit of able technical advisers, and it seems probable that its activities will expand. At any rate it is notable as being the first large-scale electrochemical industry established successfully in the State of Washington.

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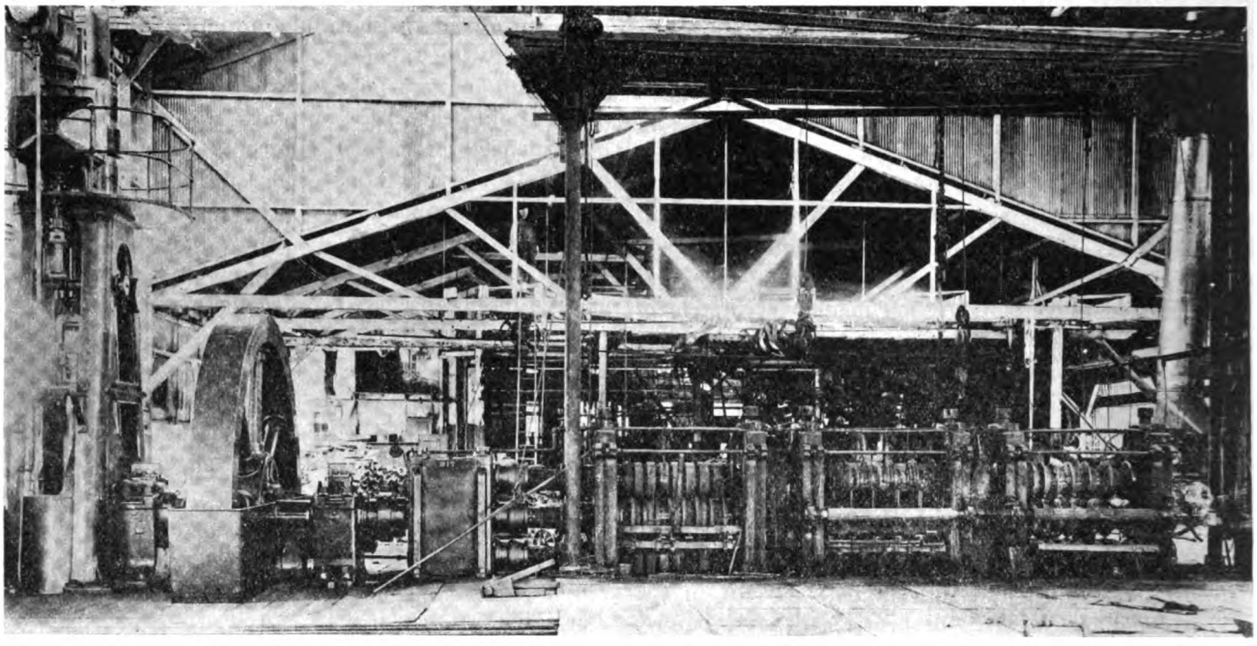
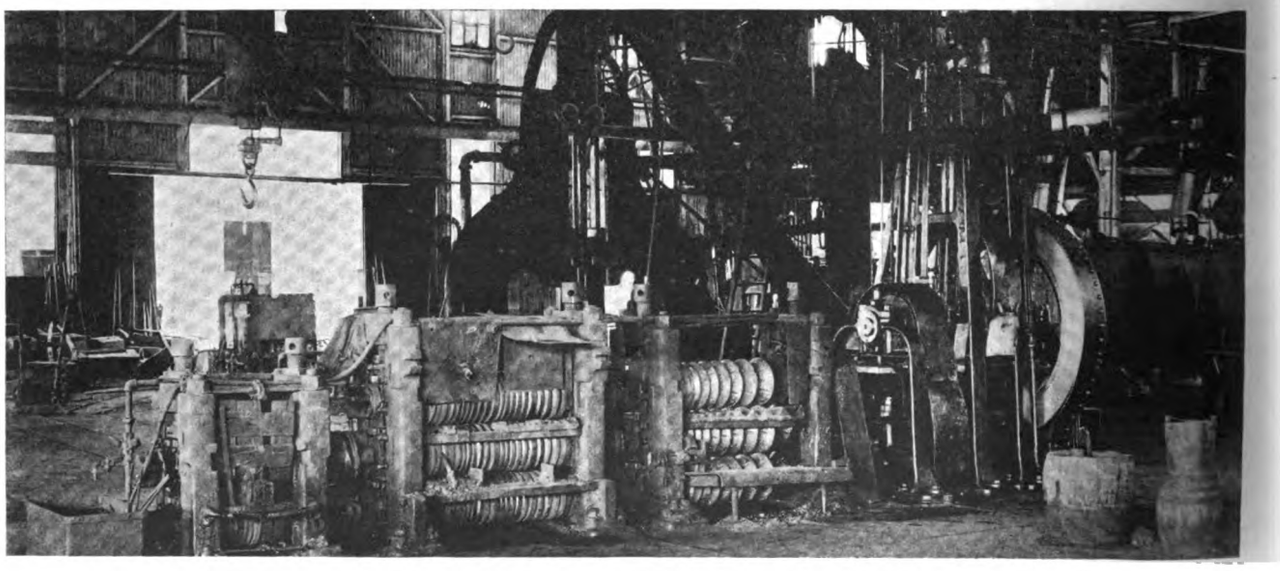


THREE-STAND MILL

Rolling-Mill and Forge-Shop Practice at the Sacramento Shops of the Southern Pacific Company

To provide most of the rolled material used in both construction and repair on its system, the Southern Pacific Co. maintains a rolling-mill at its shops at Sacramento, comprising four mills. Rods up to 3½ in. diam., flats up to 2 by 9 in., splice-bars, tie-plates, car-axles, and a number of special shapes are rolled.

Scrap alone is used for charging the furnaces. This is prepared at the scrap-dump, which is near the shop-buildings. Scrap from all parts of the company's system is collected and sorted there. Articles that can be used again in their present form are repaired, either at the shops, or in the case of some of the simpler repairs, such as re-threading bolts and nuts and sharpening spikes, the work is done right at the scrap-dump. Other articles which may seem to the uninitiated to have outlived their term of usefulness, are, after some judicious transformations in the forge-shop, prepared for further service. For instance, the ordinary springs used on car-trucks,



TWO-STAND MILL. STEAM-HAMMER IN REAR

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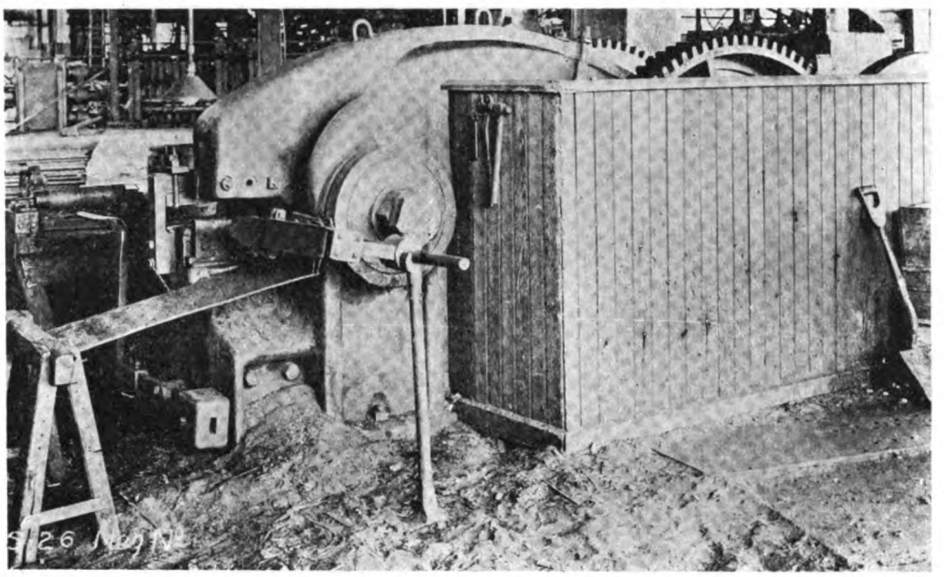
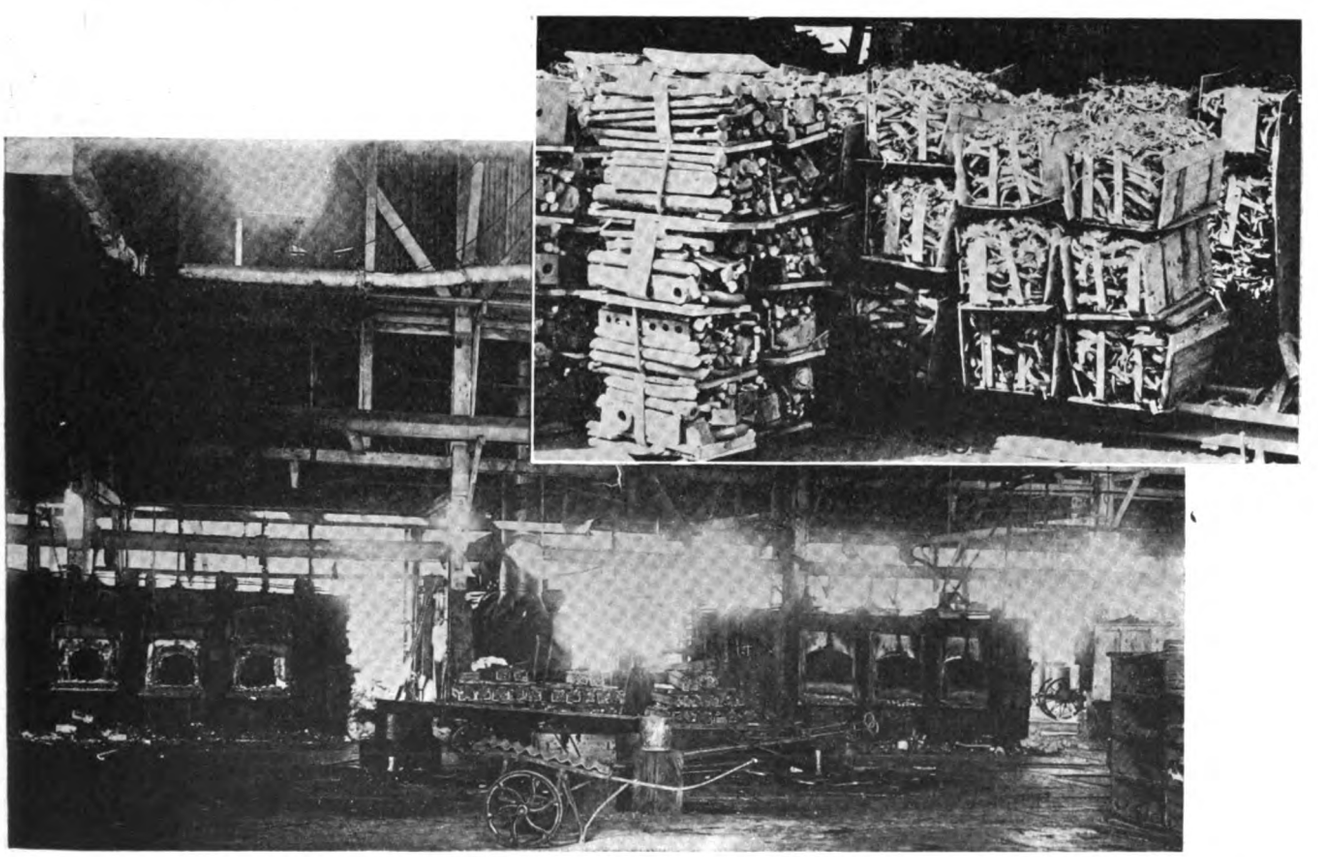
after reaching the point where they be of no further service in that capacity, are straightened in a machine especially designed for the purpose, and then forged into either the rolling-mill or the foundry furnaces, as the case may be.

Wrought-iron is carefully separated from steel scrap



SHEARS IN ROLLING-MILL

pinch-bars, hooks, or similar tools. However, the reclamation of railroad scrap is a large subject in itself, and is outside the scope of this article. Most of the material received at the scrap-dump is suitable only for charging at the dump and both are cut into pieces short enough and straight enough to be packed in the manner described below. Two 3 by 4-in. angles about 3 ft. 6 in. long are laid edge to edge so as to form a sort of trough 6 in. wide,



FURNACES WITH BUNDLED SCRAP IN CENTRE. ABOVE, NEAR VIEW OF SCRAP BUNDLED IN A DIFFERENT WAY

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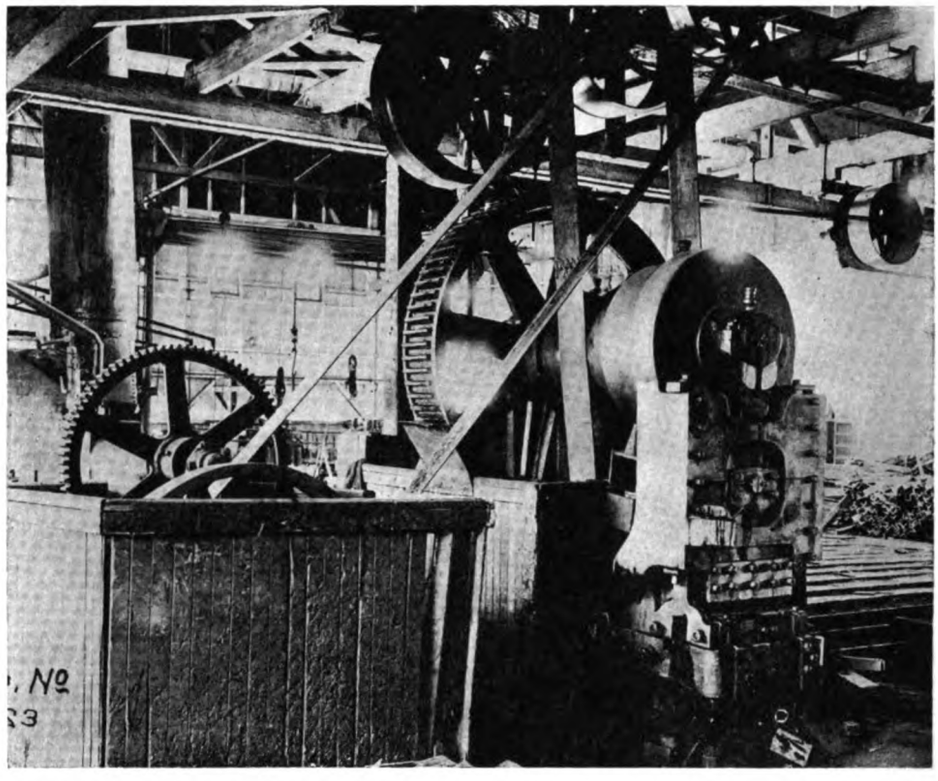
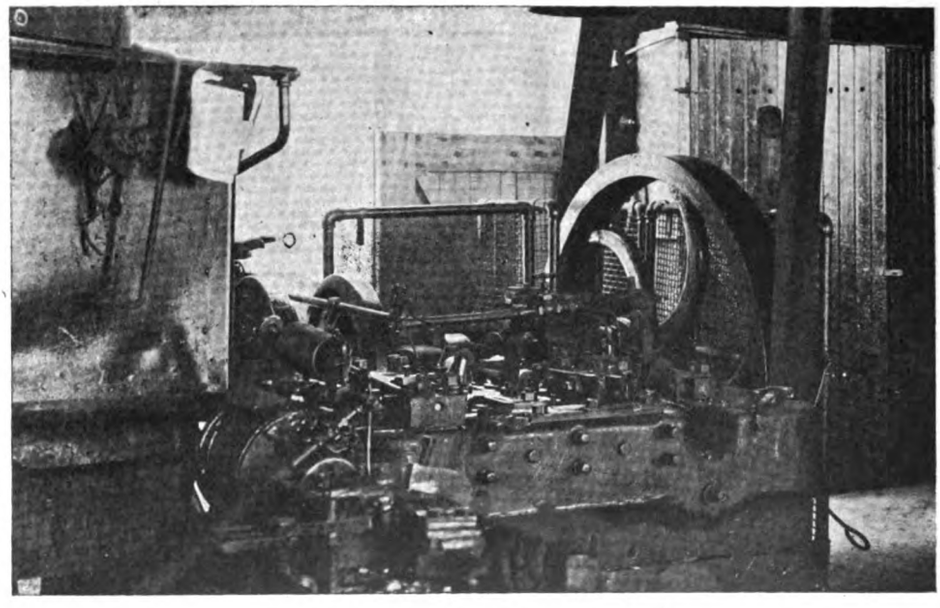
4 in. deep, and having the same length as the original angles. In this trough is placed selected scrap, packed as tightly as can be done conveniently, and one or two flat pieces are laid on top. The bundle is bound loosely with two wire-ties, the whole weighing about 300 lb. These bundles are placed in bunches of six on tray-frames, which are loaded on flat-cars by means of lift-trucks and are unloaded at the rolling-mill in the same way. For rolling ordinary merchant-bar and for most other purposes, wrought-iron scrap is charged into the furnaces. For certain special purposes such as bar-steel, steel scrap is used.



MACHINE FOR SHEARING AND PUNCHING TIE-PLATE

The furnaces are oil-fired. The scrap charged remains in the furnace until each piece becomes virtually a short forging-billet, when it is taken out and rolled in the particular mill designed for the desired product. Flats and rounds are piled when cool on storing-racks adjacent to the mill, from which they are drawn by the various



MACHINE FOR FORGING 'HAND-HOLDS'

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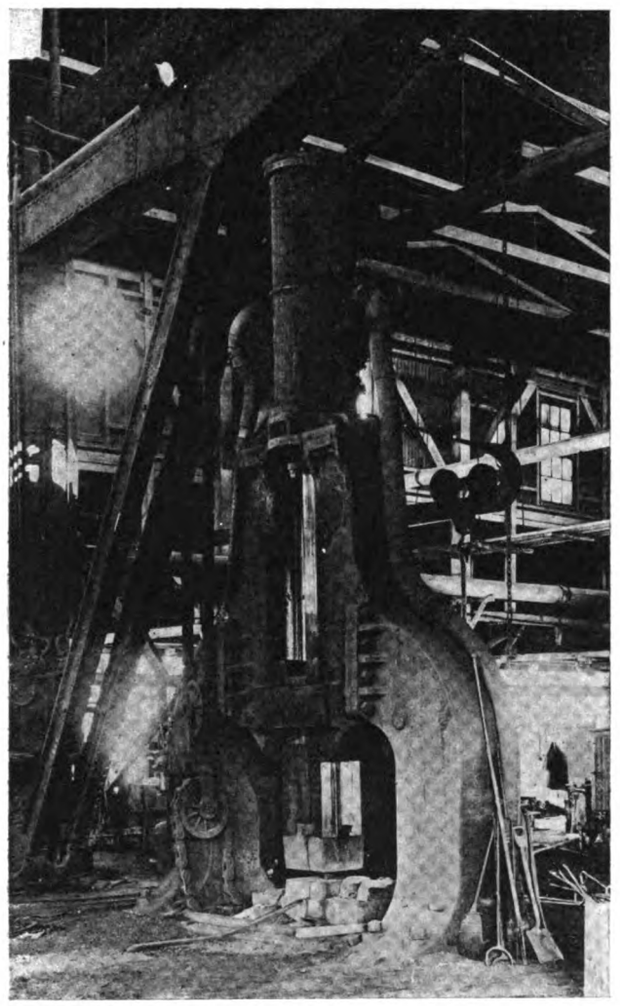
departments upon requisition. Splice-bars are rolled in a mill that gives them their exact final shape, and are then cut to length and the bolt-holes punched on one machine, and finished by cutting the spike-notches in a machine immediately adjoining. Tie-plates are rolled to final shape in the mill, and then pass to a machine that cuts them to length and punches the spike-holes in one operation. When the mill is running on tie-plates, as many as 7000 are made in one day. An interesting feature of the tie-plate work is the reclamation of plates that have been turned in because heavier rails are being laid.



5000-LB. STEAM-HAMMER

Such plates are entirely sound, and they are re-punched for use with a 62-lb. rail and are then put in sidings, branch-lines, and other places where a light rail is employed. All rolled material is subjected to a rigid inspection, much sound material being returned to the scrap-pile because of surface and other minor defects.

A considerable part of the rolling-mill stock is rolled into a flat bar about 1 by 4 in. section. This is used generally for forging special and irregularly shaped articles. This stock, not having been through the mill as many times as the regular merchant bar, represents less expense, while on the other hand, the amount required for a particular forging can be computed with an accuracy that would be impossible if the stock was cut directly from a forging-billet. All such work is figured carefully to determine the amount to be cut from the bar, due allowance being made for upsets, curved pieces, eyes, etc., so that the waste in cutting is reduced to a minimum.

The company's needs are so large, and in the case of any given article, so nearly constant, as to call for the most advanced quantity-production methods. It is usually feasible in the manufacture of any given article in general use to employ a machine specially designed for the work, and to keep that machine running continuously on the one job. Nowhere is this fact better exemplified than in the department where bolts, rivets, and similar standard articles are made. The stock is delivered to the operators already cut to length. Each furnace serves two machines, a water-curtain protecting the men from the fierce heat and making it possible for them to work at their machines in comfort and at the same time to be in easy reach of the furnaces. One of the most interesting processes is the making of the 'hand-holds' placed on the sides of cars for the use of the train-crew. The stock, which has already been cut to length, is upset in an ordinary upsetting machine. The rods are then re-heated and finished on a second machine, as follows: One movement of the machine flattens the 'upset' and punches the bolt-hole. The two bends are then made in succession. An inspection by the operator and occasionally a little truing-up with a hand-hammer completes the work on one end. The other end is then heated and finished in the same way.

Many interesting devices have been developed in the forge-shop for making special and frequently rather complicated forgings at one operation. A number of these are operated by compressed-air machines made in the shop. They are mounted on trucks so as to be portable and are actuated by old air-brake cylinders.

Acknowledgment should be made to H. C. Venter, general foreman of the locomotive department and J. Harkin, foreman of the rolling-mill and forge departments for co-operation in the preparation of this article.

STEEL-MAKING in British Columbia is once more under discussion. A small experimental plant, dealing with native ore, has been in operation for some months, and progress has been made in methods of treatment. In 1918 a law was passed providing a Provincial bonus of $1.50 per ton on pig-iron made from imported ore, and $3 per ton on iron made from domestic ore. This bonus will remain in force until 1925, in the hope of encouraging private capital, but so far it has not had the desired effect. The plan now proposed but not yet adopted is for the Provincial government to go into the business. British Columbia has some excellent magnetite ore, suitable for reduction in the ordinary blast-furnace, and containing 52½% iron. Hematite ore is also available. Besides the deposits within the Province, there is considerable iron ore in Washington.

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Maintaining Interest in 'Safety-First'

In Bulletin No. 256, issued by the Bureau of Labor Statistics of the U. S. Department of Labor, 'Accidents and Accident Prevention in the Machine-Building Industries,' by Lucian W. Chaney, there is a discussion of methods of maintaining interest in safety work in a factory after the first novelty has worn off. The system used by one company is described by one of its officers:

The accident-prevention score-board stands just inside the main gate of the factory. It is 24 ft. long, and on it are shown the departments, foremen, percentages for the month, and rank of the various competing divisions.

The starting point is 1000 both for the year and for the month. Each division is penalized according to its accidents, minor accidents causing less than one day's absence not as yet being considered. Each day's absence bears a percentage charge in proportion to the total number of 'men-days' per month per division.

There are 26 divisions in the competition of various degrees of natural hazard and of wide variation in numbers of men. The degree of hazard is disregarded in our business, which covers the same general subject throughout the plant, the differentiation being considered as equalized in the choice or selection of men with reference to their ability and fitness for their respective class of work. As to the variation in sizes and groups of workers, we meet this by establishing a differential charge per man per day for time off, which is computed by reducing each division to men-days for each month. In this manner large and small divisions are equal as to their penalties.

We disregard small accidents that do not entail appreciable loss of time, and we do not penalize for the remainder of the day on which the accident occurs. It is possible by this provision to ensure the prompt reporting of all accidents, however small, so that we may be sure of proper attendance and avoid, as far as possible, such suffering as may be otherwise charged to secrecy on the part of either men or division superintendents.

At the end of 12 months the employees of the divisions scoring 1000 receive two days' extra pay, or such part of that amount as their time and employment bears to the full year. If none score 1000, then the highest ranking department receives two days' extra pay and the second highest one day's extra pay. General foremen of any division under them earning these premiums also participate on the same basis, but may earn but one prize if other divisions under them make a perfect score.

The original plan was to distribute $25 in cash each month to all foremen of divisions earning perfect scores; but, due to the relative importance and efforts of the foremen, and the widely varying number of men with which they have to deal, we were obliged, in fairness, to change this arrangement so that one-half of each prize is paid on a flat basis and one-half distributed according to the number of men overseen. Thus, a foreman in charge of 50 men will get a proportionately larger premium than one in charge of 10 men. It may be noticed that the cash prize is rather small, and to some might be even considered trivial; but to such there has not come the meaning of the spirit back of the accident-preventing board as it prevails in our factory. It is the difference between success and loss that counts, and men who work at the lathe, the forge, or the cupola have the same aspirations to participate in the winning spirit that inspires any team or organization, however or whenever formed. It is the aim of each division to head the list, and they must feel that they have a chance of winning throughout the year. The principal attention is concentrated on the yearly contest, and the discouragement of any unfavorable monthly showing is avoided.

We have found that this system is a matter of personal interest to both foremen and employees, and so intense has the competition become at times that an unforeseen condition arises, which must be met by diplomacy, and that is the ill-feeling that may be occasioned against a worker who has been responsible for causes that might have been controlled. Careful investigation and study has shown that the personal interest manifests itself, and the feeling that the loss must be minimized is responsible to a great extent toward urging them to get back to work as quickly as possible. The foremen of the various divisions of the factory are members of a safety committee which meets at regular intervals under the direction of the general superintendent. A board of governors of five looks after the details of inspection, reports, investigates complaints, and approves the monthly penalty charges. This has served as an admirable means for the further education of foremen in matters pertaining to accident prevention, as well as sanitation, cleanliness, and fire prevention.

Boycott of Japanese Goods Opens Chinese Markets to American Manufacturers

T. Y. Zi, delegate from the Chinese General Chamber of Commerce to the Foreign Trade Convention held last month in San Francisco, states that Japan has lost 90% of her Chinese trade since the boycott was started a year ago. During the War Japan built up a large business with China, particularly in goods that America and other foreign countries were unable for a time to export. Since the boycott this market is open once more. Mr. Zi also states that the Chinese prefer American motors and engines and there are large possibilities for business along these lines. The trouble between North and South China he considers to be simply political and to have no bearing on the mercantile and industrial life of the country.

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Eliminating Accidents by Safeguarding Machinery

The Bureau of Labor Statistics of the U. S. Department of Labor has recently issued bulletin No. 256, 'Accidents and Accident Prevention in Machine Building' by Lucian W. Chaney. Besides giving statistics and other data regarding accidents, the bulletin discusses the prevention of accidents by the use of the proper safeguards for the machine-tools and other equipment used, such safeguards as are now being included with the equipment furnished by progressive manufacturers. In part, the bulletin says the following:

In the machine-building industry cranes and hoists stand third in accident frequency and fourth in severity. It is probably true that faulty methods of operation have been more responsible for this record than has faulty construction. The degree to which construction has needed modification is clearly indicated by the specifications adopted by the iron and steel electrical engineers.

The gantry-crane has been responsible for a great many injuries from the fact that the track on which it moves is at the ground-level. A wheel-guard is now being incorporated in the design.

The use of the traveling crane has brought about a marked change in shop-building construction. Since the walls must bear the weight of the apparatus and of the loads conveyed by it they must be made sufficiently strong and also given height enough to permit the transit of materials above any obstructions which may be upon the floor. Indeed, in some erecting shops where large work is handled, cranes travel at two levels, one above the other.

To present in general terms some of the dangers of crane-operation and their remedies, beginning with the craneman, the first essential is safe access to his crane-cage. The elements of safety in this matter of approach are stairs, a well-placed and properly railed landing-platform, and a railed extension of the cage-floor from which there is easy access to the landing-platform. The cage should be of non-inflammable construction, and the electrical devices should be so enclosed as to minimize the chance of burn or shock. In cranes used for the constant transportation of large quantities of hot metal, provision should be made for the escape of the craneman to an outside gallery if necessary, or, perhaps better, a fireproof chamber should be provided into which the craneman can easily enter in case of emergency and from which he can manage his crane. Such provisions are imperative in steel-mills and may properly be considered in foundries where large quantities of metal are handled.

Safety in inspection and repair should be the next consideration. In the older type of crane these essential processes could be carried out only by climbing on the girders and making way precariously to the place of work. All cranes should be provided with adequate footwalks. For some small cranes, to which such walks could with difficulty be applied, repair-platforms should be constructed at the ends of the run. To the danger of falling during the process of repair, was added in the old-type crane the chance that the machine might be unexpectedly started from the crane-cage. To guard against this, either a lock removable only by the repairman could be used on the switch in the cage, or a special switch that could be thrown open when repairs began could be installed upon the top of the crane.

What the chances were of being caught when such starting occurred may be judged by reference to Fig. 1. Not only did the gears of this trolley menace the man who was working upon them but the overhung gears would from time to time break, and the falling fragments have not infrequently caused fatal injury to workmen below.

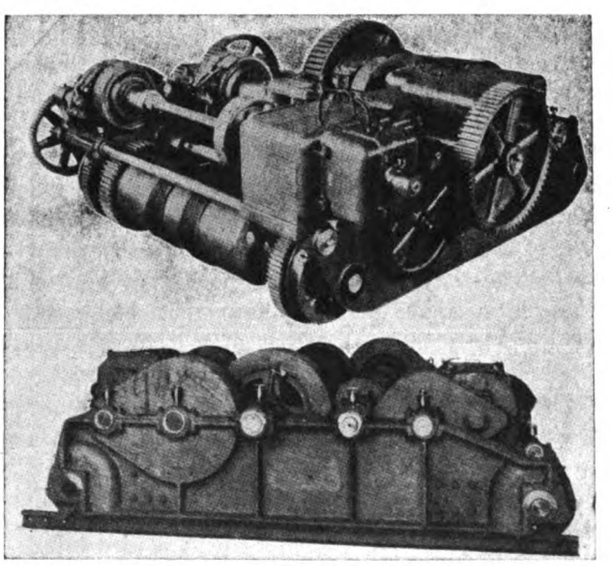

FIG. 1 AND 2. OLD AND NEW TYPE OF TRAVELING CRANE TROLLEY

Fig. 2 illustrates the thorough revision that has taken place in the design of this piece of machinery. The two pictures are of machines produced by the same company at different times. The present construction not only safeguards the man that must work upon the machines, but nothing can fall in case of breakage, and the enclosed gears, protected from grit and dust and running in oil baths, operate more smoothly and have a longer life.

It might seem that with these improvements in design and with high standards of quality in the materials and workmanship enforced, the chief difficulties of the overhead-crane menace had been met. This, however, is not true. These structural improvements prevent many serious accidents, but the larger number of those occurring are due to faulty method, to swinging loads, falling loads, to sudden or unexpected raising and lowering, and to improper management of the chains and slings by which loads are carried. One large steel company was led to make a study of the signaling system in use in their

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works, only to find that there was no system. The same signal was being used for different operations and different signals for the same operation. The result of the inquiry was the development and introduction of a definite code, which became the standard practice in all the company's mills.

In generators and motors it is noticeable that recent patterns enclose and screen the moving parts more completely than was formerly the case. In fact accidental contact with such parts is almost impossible in the cases that came under observation.

The proper installation of the wiring by which the electric current is conveyed to the machines is important both from the standpoint of fire-hazard, and because where open wiring is used, workmen engaged in other operations may come in contact with wires upon which the insulation has become worn or otherwise imperfect. The general use of metal conduits for all machine feed-wires greatly reduces these risks.

Danger to machine operators and others controlling the ultimate application of the current arises almost entirely in the manipulation of switches and controller-handles. These are now usually completely enclosed.

The demand for increased power more economically produced has led to great increases in boiler capacity, which in turn has led to the use of stronger materials and the use of more reliable structural methods. On the whole these changes have kept pace with or gone beyond the increase in size. As a result the modern boiler-room is much less likely to be the scene of a wholesale disaster from explosion than was the case some years ago, while the introduction of mechanical stokers and fuel-handling devices has appreciably reduced the danger of minor injury.

Internal-combustion engines, in general, present fewer exposed moving parts that the attendant is required by his duties to approach than was the case with former types. One added hazard must be considered. The gas used or produced in the operation of these engines is frequently noxious and has caused a number of deaths from asphyxia. It will not do to depend upon what are called natural means for preventing the accumulation of these harmful emanations. Mechanical means of ventilating and a rigorous enforcement of a rule that men shall not go alone into places where the gas may possibly accumulate are necessary. This matter has not received as much attention as it deserves.

The dangers in operating planers are: first, one which pertains in varying degrees to all machining processes, namely, flying fragments projected from the tool. These may be thrown off with sufficient force to penetrate the flesh, but more frequently are harmless except when the eye is struck; second, contact with exposed belts and gears; third, being caught by the tool when inspecting, measuring, or brushing off chips; fourth, and most serious, being caught by the moving platform or the work thereon. The use of goggles by machine-operators practically eliminates the first danger. Against the third danger no provision can be made except the care and caution of the workman. The openings in the planer bed offer a serious menace. A shop foreman was standing on the moving platform observing the progress of the work being done on the machine. As he stepped backward a nut or some other fragment upon the platform caused an unexpected disturbance of his footing and he stepped down in front of this moving platform, losing his leg. In another case the workman had some tools in the end compartment of the bed. Reaching in, his foot slipped and he fell head forward into the space and was fatally crushed.

The second illustrative case calls attention to a hazard which underlies cases of accident that appear to be due

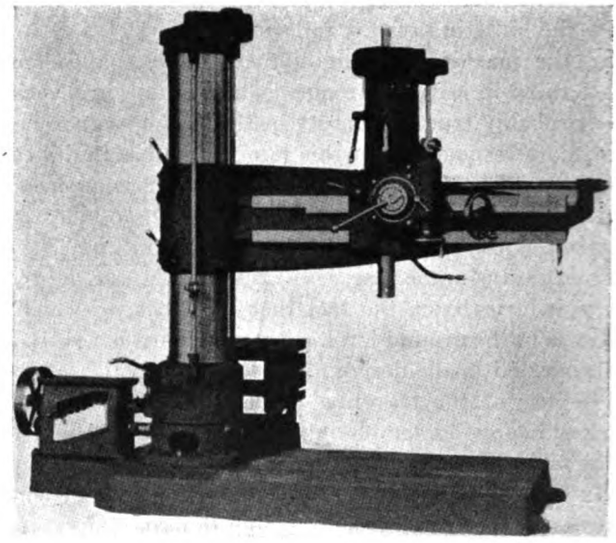

FIG. 3. MODERN TYPE OF DRILL WITH GUARDED GEARS

to other causes, namely, insecure footing. Oily floors in the vicinity of machines may probably have caused serious accidents that have appeared mysterious. The safeguard may be in proper construction of the floor, or in the shoes worn, or both. This cause of injury deserves more serious attention than it has yet received.

The dangers arising in the operation of lathes are those already enumerated and in addition one not hitherto encountered. With all revolving cylindrical objects there is danger that some loose part of the workingman's clothing may be caught. This is not serious with metal-working lathes since, even in the most rapid operation, the rate of revolution is not high enough to be seriously dangerous. When, however, there are projections on the revolving part, injuries may occur. These have been most frequent from the set-screw of the dog used to hold the work in place against the stress of the tool. Several forms of dog in which either no set-screw was used or the set-screw was securely covered have been developed in the shops, but apparently no lathe manufacturer had given the matter serious thought at the time when the field work for this study was in progress.

When gears have been properly safeguarded there remains in the drill itself a source of danger that is practically impossible to eliminate. This may be illustrated by a case or two. A workman operating a horizontal drill

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of rather large size drew the drill back from the work to make some measurement. As he bent forward, the point of the drill touched his overalls just below the hip. Instantly he was snatched from his feet and whirled around on the drill. Before the machine could be stopped by his fellows his head was repeatedly struck against the iron platform to which the work was attached, with fatal results. The foreman in charge of this work afterward devised a drill-chuck in which the drill ran free except when the drill was pressed against the resisting work. Some difficulties developed in the operation of this chuck and so far as known it has not been successfully applied in practice.

In another instance a young apprentice reached around an upright drill and was caught by the sleeve. The twisting of the drill gathered in the cloth, tearing it as it did so, until his garments were entirely removed except his shoes.

Almost the only possible safeguards appear to be the wearing of close-fitting clothing, and extra care on the part of the operator. Safeguards thus far tried have either proved ineffective or have so seriously interfered with the usefulness of the machines as to be impracticable.

In spite of the development of electric drive there remains an immense field in which mechanical transmission will for a long time, if not permanently, be of great importance.

In conveying power from the prime-mover to the first point of application some form of belt was formerly the exclusive method. With increasing size of engines it became difficult to produce belts in proportion. This led in one direction to direct connection for the generation of electricity and in the other to the substitution of rope-drive.

Such a drive requires complete housing to be safe. This instance is on record: A strand of the drive broke, the loose end wrapped around a railing, tore it from its fastenings, and, carrying it to the far end of the drive, struck a man standing there, inflicting serious injury. Since the safeguards in this case cannot be made an integral part of the machine the manufacturer's duty becomes that of giving proper advice to his customer rather than that of modifying his design.

Following the distribution of power still farther, the line-shaft is reached. The primary danger from this is to the oiler who must approach the swiftly revolving shaft in the prosecution of his duties. This always involves danger, but it is aggravated when the shaft has projecting set-screws. This danger is obviated when these screws are of the safety pattern or are properly covered. A still more effective safety device is the use of self-lubricating bearings. These when properly constructed need no attention for considerable periods and any necessary attention can easily be given when the mill is not running. These self-oiling bearings can be attached not only to line-shafting but to countershafts as well, and thus eliminate entirely a dangerous practice.

The secondary danger of shafting is with the belts by which power is finally brought to the machines. If a workman is caught by such a belt it becomes of the utmost importance that he or his fellows be able promptly to stop the movement of the shaft. If to do this requires communication with the power-house, the stoppage will probably be useful only for the removal of the injured man. Both for safety and for economy in the use of power the sub-division of the power transmission into small units, which can be independently brought to rest, is of the highest importance. This control of reasonably small portions of the transmission equipment is made possible by the use of friction-clutches. Arrangements, mechanical or electrical, for the operation of these can be placed at various points so that in case a man is caught, some one will be able promptly to disconnect from the source of power the part of the transmission involved.

The manufacturers of machines are now ready to furnish machines safe so far as mechanical device can make them. It remains for users of machines to put into their shops only those which embody these safeguards. Unsafe machines can still be bought at some saving in price. A single accident might wipe out years of such saving.

Market for Machinery in the Philippines

As a market for modern machinery of nearly every kind, says the 'Commerce Monthly', issued by the National Bank of Commerce of New York, the Philippine Islands have been little more than touched. The erection of sugar centrals with modern mills is a comparatively new thing, centrifugal sugar being first reported separately in the export statistics in 1918, when it amounted to 23% of the total. These conditions, together with the probable expansion of the sugar industry offer a large field for sugar-machinery. The need for economizing cargo-space, has shown the advantages of shipping cocoanut-oil instead of copra, and this has created a great demand for oil-extracting machinery, which constituted the largest item of machinery imports in the calendar year 1918. The canning of pine-apple and of sea-foods has also been started recently. With the expansion of these industries will come demands for fruit-handling and canning machinery, while the progress of industrial development in all lines will in time make a corresponding demand for power-plant equipment.

In the year ended June 30, 1919, the total imports of iron, steel, and manufactures were valued at $14,799,000, of which 90% came from the United States. The value of machinery imported was $7,101,000. The financing of imports of machinery ought not to present the difficulties that accompany financing trade with European countries at the present time, since the balance of trade in favor of the Philippine Islands was $5,400,000 during the year ended June 30, 1919, and for the six years ended on that date amounted to over $50,000,000. With the United States in particular, however, there was a balance unfavorable to the Philippine Islands of $4,000,000, in a total of exports and imports combined of $137,000,000.

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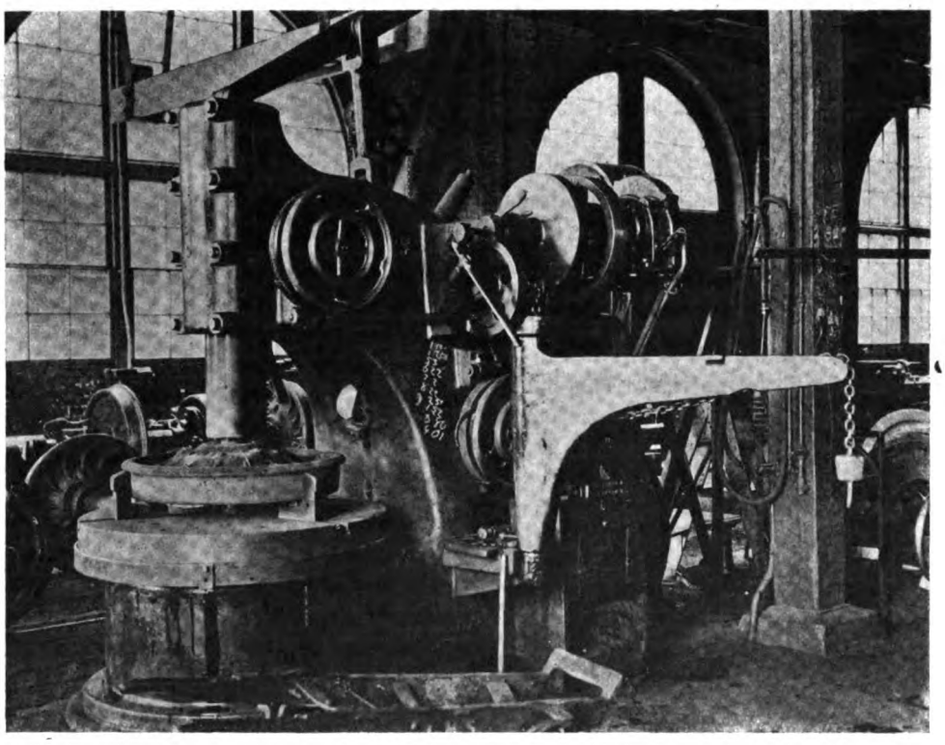
Manufacture of Car-Wheels at the Sacramento Shops of the Southern Pacific Company

There are few foundries on the Pacific Coast where a larger tonnage is cast than in the car-wheel department of the gray-iron foundry at the Sacramento shops of the Southern Pacific Co. The wheel foundry occupies one end of the main foundry building and is served by its own 72-in. cupola. About 108 tons of metal is poured per day, and the average daily output is 270 freight-car wheels, ranging in weight from 625 to 700 lb., the lighter wheel being for the 30-ton car and the heavier for the 50-ton.

The cupola charge averages 80% cast-iron scrap, 5% steel scrap, and 15% pig-iron. The principal source of cast scrap is the old wheels that have reached the point where they are incapable of further re-grinding, according to the method to be described below. A low-silicon mixture is required to give the hardness necessary for the service.



BORING CAR-WHEELS ON NILES MILL

Molding is done by hand. Two men working together can put up a mold in about 10 minutes. Each pair of molders group their work around a stationary floor-crane. Chills are placed around the circumference of each wheel to give the required hardness. The chilled surface is from $\frac{3}{4}$ to 1 in. deep. The wheels are cast in groups of six. As soon as possible, and usually within 10 minutes from the time of pouring, the molders commence uncovering the wheels and knocking off the risers, the latter being returned to the cupola charge. In about 30 minutes from the time of pouring, the wheels have been placed in the annealing-pits. At this time they are still hot enough to show a red glow on a dark day. These pits are simply circular wells in the sandy soil lined with firebrick, and provided with a metal cover. The diameter is just large enough to admit the wheels easily, and the depth is sufficient to contain 18 wheels. The only source of heat is the wheels themselves. The wheels cool in these pits for four days, and when removed are still slightly above atmospheric temperature.

Four wheels are tested each day according to the tests approved by the Master Car Builders' Association. Two of these are given what is called the thermal test, which consists of setting the wheel in the sand with a channel about two inches wide around its circumference. A ring of hot iron is poured into this channel. The heat from this metal expands the rim of the wheel rapidly, and generally cracks the web of the wheel. If the wheel does not crack through the rim or tread within two minutes from the time of pouring the iron, the wheels are passed. If it does, all wheels in the heat of the same tape-size are scrapped. This test is to guard against the wheels being heated by the pressure of the brake against the

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wheel when running in service. The two other wheels are subjected to a drop test from a 200-lb. hammer according to the weight of the car for which the wheel is designed. Control of the cupola mixture is maintained by taking samples at intervals during the day, and observing the fracture upon breaking a chilled test-bar.

From the annealing-pits the wheels go to the sand-blasting room, and from there are sent in pairs to the car-wheel machine-shop. The first operation there is to bore and face the hub, which is done on a Niles boring-mill. The steel axles are calipered and the wheels bored about 0.008 in. undersize, to give a force fit. The tool-holder is equipped with a micrometer for setting the tools directly. Both the roughing and the finishing cuts are taken at the same time.

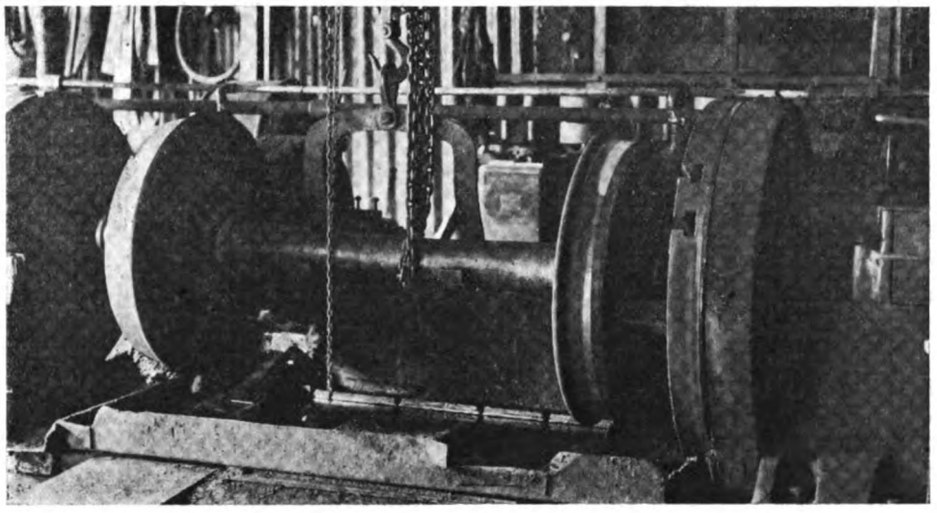
After boring, the wheels are pressed on the axle in a hydraulic press, the pressure required ranging between limits of 30 to 40 tons for the wheels used on 30-ton cars up to limits of 60 to 70 tons on the wheels for 50-ton cars. The press is equipped with a recording device that gives a graphic record of each day's work, showing not only the pressure used for each wheel, but also the length of the fit over which the pressure was applied. This eliminates the danger of sending out a wheel that is a tight fit over a relatively small part of the axle. All wheels are numbered, so that failures or defects in service can be checked against the record of the press.

Wheels that have developed 'flat spots' in service are ground down in a machine of special design, using a 3 by 26-in. alundum wheel running at the rate of 900 revolutions per minute. A 30-hp. motor is required to drive the machine. The limit of the re-grinding operation is the depth of chill, from $\frac{3}{4}$ to 1 in. As soon as the soft interior iron is reached, the wheel is useless for further service and is sent to the foundry as scrap. The circumference of wheels on same axle should not vary more than $\frac{1}{8}$ in., and the circumference of those on the same car should not vary more than $\frac{3}{4}$ inch.

Condemned wheels are removed from the axles in a press somewhat similar to the one used for pressing them on the axles, and which has a maximum capacity of 600 tons. This de-mounting press forces off both wheels at the same time.

Locomotive-wheels and wheels for passenger-cars are made from rolled steel, and are obtained from various Eastern manufacturers. The machine-shop work is similar to that for the cast-iron wheels except that the steel wheels are not so hard and, therefore, they can be turned in the lathe instead of ground.

Acknowledgment should be made to J. H. Geiger, foreman of the foundry, and F. A. Webb, foreman of the car-wheel shop, for assistance in preparing this article.



APPARATUS FOR GRINDING FLAT SPOTS FROM WHEELS

Diesel-Electric Drive Applied to Vessels

Probably the first trial of a Diesel-electric drive for ships is on the yacht 'Elfay', a schooner of 152 ft. overall, 30-ft. beam, and 313 gross tons capacity. The yacht is driven by a 6-cylinder Winton Diesel engine rated at 115 hp., at 425 r.p.m., direct-connected to a 9-kw. exciter. The motor for the propeller is rated at 90 hp., at 360 r.p.m. The entire boat is operated and controlled by electricity, no steam being used or required. All the auxiliaries are electric-driven and all movements are controlled from the bridge without having to signal the engine-room.

The yacht is said to make $8\frac{1}{2}$ knots on $7\frac{1}{2}$ gal. of fuel per hour; and since she can carry 2400 gal. of fuel, she is able to run 2000 miles on her propelling equipment alone. Although the 'Elfay' is by no means a typical merchant-vessel, it is believed that if the new drive proves successful on her it will be extended to purely commercial ships. In fact, consideration is now given to the application of Diesel-electric power to some of the wooden freight-vessels of the Ferris type now offered by the U. S. Shipping Board, where there is not sufficient headroom in the hold for boilers and engines of the usual type.

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Prevention of Accidents in Foundries and Shops

The Bureau of Labor Statistics of the U. S. Department of Labor has issued Bulletin No. 256, 'Accidents and Accident Prevention in Machine Building', by Lucian W. Chaney. Regarding special measures for accident prevention in the foundry, the bulletin says, in part:

A primary necessity is for the safe movement of material. The character of the work done in a foundry renders it easy for it to fall into a disorderly condition. The passageways become choked with debris and with apparatus awaiting its turn for use. With large castings particularly there is a considerable amount of material, partly usable and partly useless, derived from each operation. Without rigid rules and close supervision a chaotic condition soon prevails.

Many foremen insist that this condition is inevitable where work is being turned out rapidly, and it is true that disorderly conditions and large output frequently go together. The fact remains, however, that while no exact figures have been obtainable, the investigation has failed to produce a single instance in which the development of more orderly methods has not been accompanied by greater output. So uniform has been this experience as to cast grave doubt upon the insistence of disorderly foundries that they could not afford better order because it would decrease production.

The maintenance of clear aisles and the orderly disposition of apparatus have a direct bearing upon safety. In foundries where it is not the rule the men are endangered every time they attempt to pass from one part of the foundry to another, and since work is done on every part of the floor, crane loads cannot be carried without passing above the workers at some point.

As the metal comes down the runner from the cupola, sparking is likely to occur. When the metal falls into the ladle these sparks are particularly likely to be projected forward in the direction of the workman. To avoid this, one foundry has adopted runners with a turn near the end at nearly right angles. As a result, the metal when falling into the ladle is not moving toward the tapper, who must stand opposite the tapping-hole when opening it. Since ladles are suspended at a point but slightly above the centre of gravity appropriate means of locking much be utilized to prevent oversetting and due care exercised not to overfill.

In the transfer of the metal to the molds two precautions are important. The sparking of the metal above mentioned suggests some protection for the eyes. Since the time during which this protection is required is brief it may be afforded by inexpensive glasses, which would not be usable for the prolonged wearing necessary in the cleaning-room. Eye injuries from flying sparks are sufficiently numerous and serious to demand this attention.

Among the most frequent and serious injuries in foundry operations are burns of the feet occurring during the pouring of castings. At times serious explosions and break-outs may occur. Foundry fatalities are sometimes due to such causes, but they are fortunately rare and the losses are much less than those arising from the frequent recurrence of minor burns.

For the majority of foot-burns there is no excuse. If the employer provides proper means of protection and insists upon their use these injuries can be practically eliminated. It is altogether a question of proper shoes and the use of leggings during the operation. What is coming to be known as the foundryman's shoe is of specially prepared leather not easily affected by heat and having rubber-cloth gores at the sides so that it can be removed readily. Since such shoes cannot be easily obtained in the general market, many foundry owners are now securing and keeping on hand a supply for the

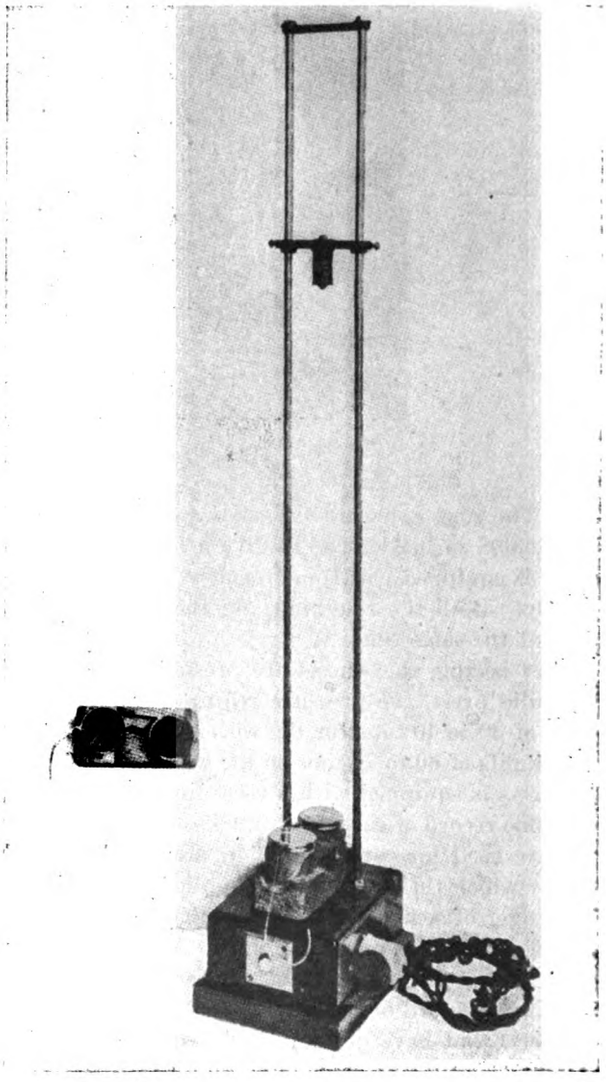

FIG. 1. APPARATUS FOR TESTING GOGGLES

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benefit of their employees. If with this shoe a suitable canvas legging is worn when pouring, the foot-burns become rare.

The cleaning-room has two dangers, dust and flying metal. Dust frequently is so serious a menace to health that either respirators should be worn or a dustless method of cleaning adopted. One foundry observed has introduced such a method. It consists of a high-pressure stream of water. One man using this method cleans a greater number of castings than several by the old method. The quantity of water used makes necessary special means for its disposal and this together with the difficulties incidental to cold weather is an obstacle to the use of this method, but its speed and thoroughness, and the absence of dust, render it worth consideration.

The remedy for eye injuries is the use of proper goggles. Emphasis is placed upon 'proper', since in the early attempts to meet the situation there was much complaint of the refusal of the workman to use the protection when furnished. They were fully justified in their antipathy. Ordinary glass has uneven surfaces and, when used in goggles, gives the effect of a number of irregular prisms before the eyes. A few minutes' wear of such a glass produces discomfort and prolonged wear causes serious pain. If persistently used, such goggles cause grave injury to the eyes.

Proper goggles must have three qualifications: First, clearness and accurate surfaces; second, a mounting that can be adjusted, either by selection or changed shape, to the individual wearing the goggles; third, sufficient strength to withstand the blows of flying particles, or, if the glass yields, it must do so without itself giving rise to flying pieces. An employer should not be satisfied with the assurance of the dealer regarding this last point. He should insist upon tests. Several large buyers have devised testing apparatus to which they subject each lot purchased, rejecting the lot if it fails to come up to the required standard.

The apparatus of the American Car & Foundry Co. and their requirements of the goggles they purchase are here described.

The sliding carrier shown in Fig. 1 holds a steel ball $\frac{5}{8}$ in. diam., weighing not less than 16 grams. The goggles are supported as shown and the ball drops upon pressing the button in the base. The specifications for the goggles are given below.

Not long ago there was not in the market a goggle that would meet these standards even approximately. Now they may be obtained without difficulty.

Specifications for Testing Goggles

1. *Drop-test Machine.* The drop-test machine to consist of a support for the goggles made of white pine; the support being designed to accommodate the goggles under test in such a manner that the frame of the goggles is given proper bearing on the rubber and cotton composition strips without permitting the lens itself to rest on the support or to receive any 'backing', other than that naturally given by its own frame. A representative form of support is shown in Fig. 1.

2. *Height of Drop.* Twenty-one inches from bottom of ball to the surface of the goggle-lens.

3. *Size and Weight of Ball.* The ball to be made of steel and hardened. The diameter will be $\frac{5}{8}$ in. and the weight not less than 16 grams. When released the ball must fall freely without any initial momentum.

4. *Extreme Variations Allowed in the Thickness of a Single Lens.* Five millimetres. The measurement of the thickness to be taken with a standard gauge used by opticians at five points.

5. *Extreme Variation in Thickness allowed Between Two Lenses of the Same Pair of Goggles.* Ten millimetres. The measurement of the thickness of each lens to be taken as described in paragraph 4.

6. *Number of Blows.* The maximum number of blows to be given is 15; the blows to be given consecutively on the centre of the lenses and on the surface of the lens which is exposed to flying matter.

7. *Number of Tests.* On each shipment of one gross of goggles, one dozen of the gross must be tested as described in paragraphs 4, 5, and 6, and of this dozen, 25%, or three pairs of goggles, must stand 15 blows without breaking or cracking. This means that both lenses of at least three pairs of goggles in the test-dozen must be intact after 15 blows. If less than 25% stand the test the entire gross will be rejected.

8. *Flying Chips of Glass.* If in the test-dozen of goggles, any goggles break under the drop in such a way that glass will fly from the inside-surface of the lens, meaning the surface that is next to the eyes of the men wearing the goggles, then the entire gross will be rejected, even if three pairs of goggles have stood the number of blows required in paragraph 7.

With the growth of oxy-acetylene and arc welding and other industrial operations of similar character, another method of eye protection becomes of importance, the use of suitably colored glasses. This has received small attention until recently, it being assumed that any coloring of the glass reducing intensity served the purpose. With the advent of the intense heat and light of the arc this impression is being rapidly destroyed.

A study of the conditions shows that the harmful effect is not because of the intensity of the luminous rays of these operations, but is because of the accompanying increase in the invisible rays known as the ultra-violet and the infra-red. An illustration of the power of the ultra-violet rays is seen in their capacity to destroy germs, which power is utilized in the water-sterilizers lately put upon the market. The forms of colored glass hitherto utilized for eye-protection afforded no defense against these harmful rays.

Regarding safety in the machine-shop, the bulletin says, in part, no single change in equipment has more strikingly modified conditions than the introduction of electrical drive. It has repeatedly been assumed that this introduction adds to the dangers of the shop. The argument is that there is now added to the existing hazards the chance of burns and shocks from the electric current. This takes no account of the dangers removed. A mo-

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ment's consideration will show that these are many, and that they far outweigh those added. A considerable amount of severe injury has constantly occurred in connection with the oiling of shafts and the adjustment of belts. Group electric-drive reduces this hazard, and individual-drive eliminates it altogether. More important than the elimination of shaft and belt hazard is the control over the machine. A frequent cause of injury in the old-type shop was the unexpected starting of the machine. This may occur when a shaft, stopped for some cause, begins to revolve, or the belt of the particular machine may creep from the loose pulley to the tight one. Such unexpected starting is practically impossible when the machine is set in motion by the closing of a switch.

Not only does the workman have perfect control of his machine, but it is feasible to extent this control so that it can be exercised at several points. The stoppage of a machine promptly from several points in its vicinity may make the difference between serious, even fatal, injury and complete escape.

Another element of safety is the ready and exact adjustment of the amount of power to the demands of the work in hand. This is accomplished with mechanical drive by means of cone-pulleys, gears, clutches, and other devices, but in no case can it be done with the precision possible by the use of electricity.

It is still a matter of discussion whether the use of individual motors is an economy of power. The claim is made that the operation of a given group of machines can be conducted with an expenditure of about 80% of the power required by mechanical drive. Whether this saving would offset the higher cost of electric installation is a question to be settled only by a study of the individual case.

Although less serious in results than in the chipping of castings, there are several machines in shops in which fragments are apt to fly.

Grinding-wheels are an important adjunct in machine-shop operations. Two items are worthy of attention in the safeguarding of these: First, proper mountings, and, second, hoods enclosing the wheel, so that if it explodes the pieces will not fly.

THE cashier at the terminal was familiar with the average earnings of the various car-routes. A conductor who had that day been operating on a line of known productivity handed in a meagre total for the day's receipts. "Well, thanks for bringing back the car," said the cashier, after verifying the total. "Oh, that's all right," responded the grateful conductor. "Thanks for the use of it."

The companion piece to the foregoing is the one about the enterprising conductor operating on a line having little travel, who one evening handed in a large return for the day. He explained that business that morning was light, so they had spent the afternoon running up and down several of the main lines.—'Chicago Tribune'.

The Iron Industry of China

An article in the 'Far Eastern Review' states that iron has been mined in China for centuries, reliable records going as far back as 806 A.D. There are still a number of small mines and furnaces employing native methods, and which produce in all about 180,000 tons per year. The introduction of improved methods came in 1896, when modern furnaces were built at the Hanyang Iron Works. In 1915, the Penchihu company was established. The total output of these two concerns is now 200,000 tons per year.

The principal producer of iron ore is the Hanyehping Co., which controls the Tayeh mines. These mines produce about 630,000 tons per year, about half of which is smelted at the Hanyang works and the remainder exported as ore to Japan. The exports to Japan are under an agreement concluded in 1913, which provided that during a period of 40 years from that date the Hanyehping Co. would sell a total of 15,000,000 tons of first-class ore to Japanese iron-works.

The Hanyang Iron Works has two old and two new furnaces with a total capacity of 600 to 700 tons per day. The steel department is equipped with six Siemens-Martin furnaces, with a capacity of 30 tons each. The Tayeh Iron Works has two modern furnaces with a capacity of 900 tons per day in all. The Penchihu Co. is a joint Chinese and Japanese enterprise. It operates the mines at Maiokou, Fengtien province. It has three furnaces with a total capacity of 320 tons per day. Most of the iron produced is exported to Japan. In addition, the company sends its poorer ore to Japan for concentration.

There are several smaller concerns producing iron by modern methods as well as the small native mines already mentioned. At the present time, China exports both iron ore and pig-iron to Japan, and imports about the same amount by weight of finished steel products from Japan and other countries. The exports to Japan are under various trade agreements and are likely to increase rather than diminish. Although the production of pig-iron and steel in China is likely to increase, it will probably be accompanied by a corresponding increase in the consumption (the present annual consumption per capita is only 2 lb., against 500 lb. in the United States). It is therefore unlikely that exports of pig-iron to other countries than Japan will be resumed for many years to come, and for the present China may be considered as a market for finished iron and steel products and machinery rather than as a possible source of supply of raw materials.

"So," said a friend to the man that had repented, "you can't see any way of getting out of the engagement honorably, eh?"

"No," the chap groaned. "Not unless I can lick her six brothers, all bigger men than I."—'Los Angeles Times.'

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INDUSTRIAL EQUIPMENT

THE HUMP METHOD FOR HEAT TREATING STEEL

A new method for the heat treatment of steel has recently been introduced, which promises to revolutionize hardening-room procedure and results. The purpose of heat-treating

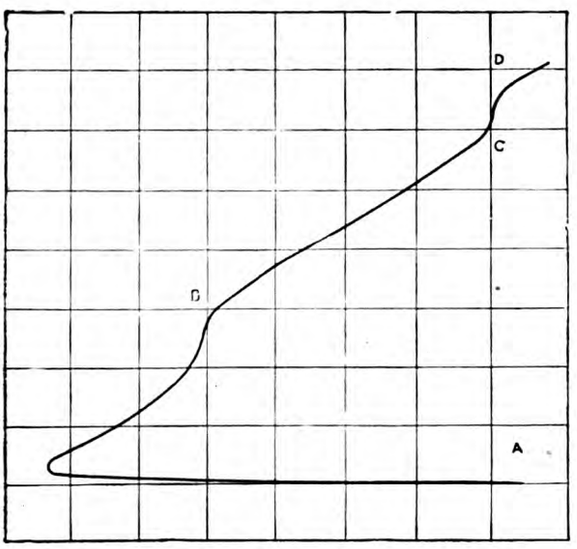

Fig. 1. Temperature Curve Showing 'Hump' at C

processes is to impart certain qualities of hardness, toughness, tensile strength, grain structure, etc., to the material, and this should be accomplished reliably without change in size or shape, without scaling or decarbonization, without waste of material by faulty treatment, and with the least possible expense for labor and supervision. In all of these

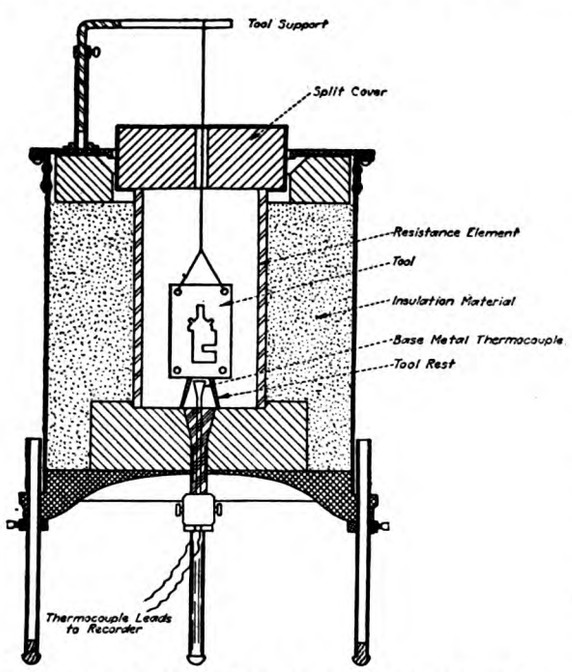

Fig. 2. Electric Furnace for Heat Treating by 'Hump' Method

respects the new method, known as the 'hump method', exerts a favorable influence upon hardening room practice.

The method, as covered by U. S. Patent No. 1,188,128, utilizes the outward manifestation of changes in internal structure which takes place when steel is heated past the so-called critical or transformation point to indicate when the work should be withdrawn from the furnace. In using this method, the temperature of the furnace, and therefore of the work, is raised at a uniform rate until the transformation point of the steel is reached. At this time there will be a marked decrease in the rate of temperature rise. This change in the rate of rise is made plainly visible to the oper-

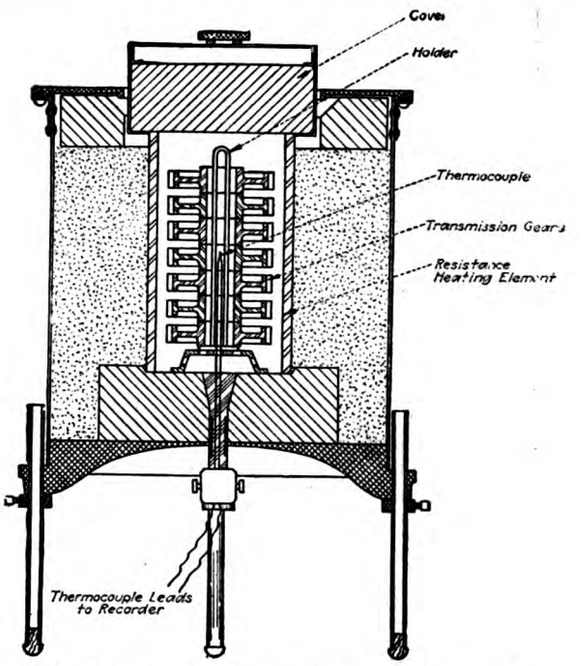

Fig. 3. Leeds & Northrup Furnace for Treating Automobile Transmission-Gears

ator by an autographic recorder connected to a thermo-couple placed close to or in contact with the work. The effect is shown clearly by a bend or hump in the curve as at C, Fig. 1.

As a guide in hardening, the temperature-pause, or decalescence point, as it is called, is more reliable than is the furnace-temperature alone. The arrest in temperature indicated by the hump or bend in the line drawn by the pyrometer-pen shows that the internal changes so momentous as affecting the qualities of the finished steel, are actually taking place, and once the proper interval to be allowed after the hump before quenching has been determined, there is no uncertainty about the results of hardening.

If, on the other hand, the work be controlled with reference to temperature readings only, there are several possible sources of error, namely:

1. The thermo-couple may be at a temperature different from that of the work, either because of insufficient time having elapsed for the work to assume the furnace temperature or because of inequalities in temperature between different parts of the furnace. Experiments made with commutating recording pyrometers connected to read alternately upon two or more thermo-couples in a single furnace show that surprising differences in temperature persist even after prolonged 'soaking'. To ensure that the work shall actually reach the desired temperature within a reasonable time, the furnace is often held at a higher temperature, which is afterward reduced. The 'soaking' and possible overheating of the work may, and often do, cause injurious growth in grain size in the metal being treated.

2. In attempting to hold the furnace at a constant temperature, the temperature may fluctuate, and even though it may subsequently be reduced to the proper temperature, the work may nevertheless have been overheated and injured. In the hump method, the quench is made as soon as the work

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is at the right distance above the critical point, and the work is given no opportunity to reach an excessive temperature.

3. The temperature assumed to be the critical temperature of the steel may not be correct. On the other hand, using the hump method, the time at which each lot of material passes through the critical point is definitely determined.

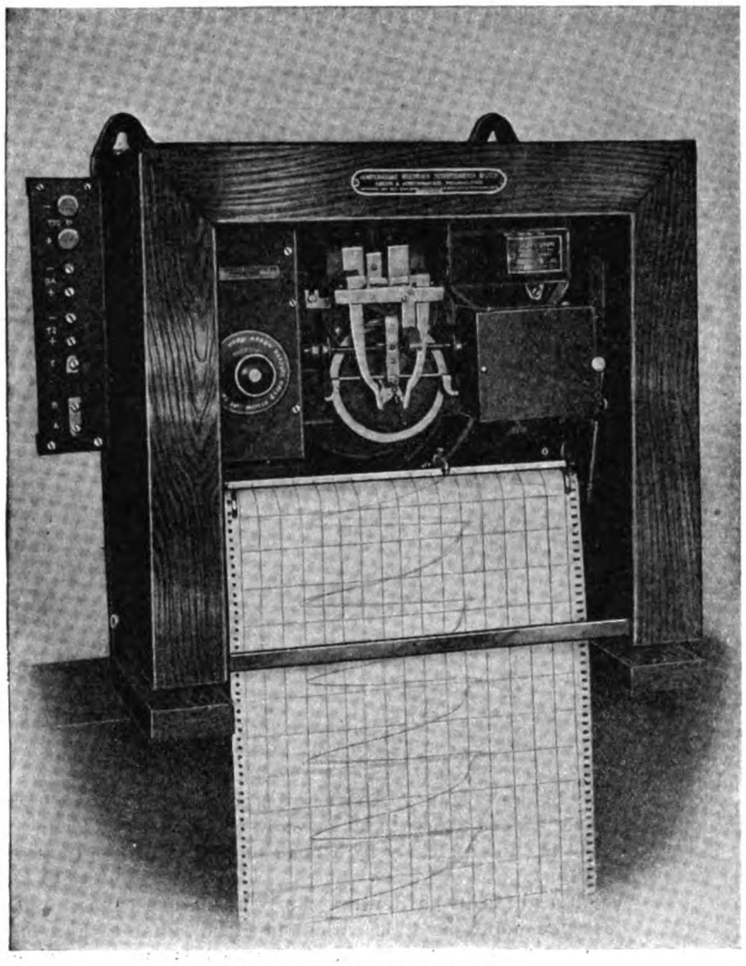

Fig. 4. Curve-Drawing Pyrometer

The lead-pot and the fused-salt bath methods of heating work for hardening, give greater assurance than does the ordinary furnace that the work shall reach a uniform temperature, but uncertainties still remain as to the actual transformation-temperature and as to the accuracy of the temperature measurement. Furthermore growth in grain size from too long immersion may occur. Lead or salt baths give no control whatever of the rate of heating. Hardening baths also have many practical disadvantages, such as expense, dirt, necessity of subsequently cleaning the work, and space occupied.

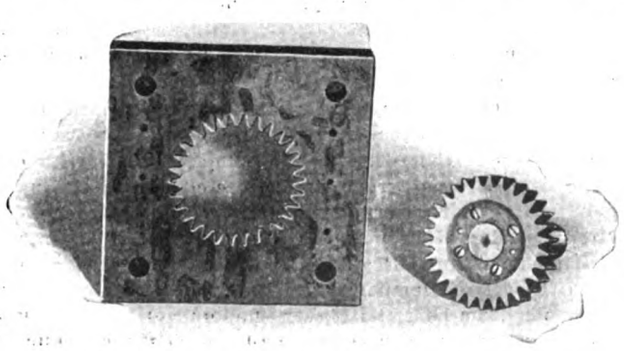

Fig. 5. Punch and Die Treated by 'Hump' Method

4. The pyrometer used for measuring furnace temperature may be inaccurate.

The user of the hump method need not concern himself about the absolute accuracy of his pyrometer, nor bother with independent transformation-point determinations. It is not at all necessary that the temperature indicated by the thermo-couple should be the correct temperature of the work, for so long as the recorder connected to the thermo-couple shows clearly the pause in temperature rise, the moment at which transformation occurs is known definitely. Having learned by trial just how many minutes should elapse after the beginning or end of the transformation before the work is removed from the furnace, he is upon sure ground and can repeat results.

Uniform standardized conditions and a control of the rate of heating the work are essential to the hump method of heat treatment. A small furnace for heat-treating tools, dies, etc., is shown in Fig. 2. The heating-element consists of a vertical cylindrical resistor, surrounded by insulating material in a sheet-iron jacket. The resistor rests upon a refractory block, which is supported by a cast-iron bottom plate. The heating-chamber is closed at the top by a refractory cover, while a cast-iron top-plate confines the loose insulating material, filling the space between resistor and jacket. An iron-constantin thermo-couple of bare No. 8 gauge wire projects upward from the centre of the bottom refractory block.

By means of a small wire attached to a tool-support on the top-plate of the furnace, the work to be treated can be suspended in close proximity to, or touching, the end of the thermo-couple. In production furnaces other methods of supporting the work are used. For example, in the furnace shown in Fig. 3, designed for heat treatment of automobile transmission gears, the work is placed upon holders before insertion in the furnace. Covers placed on the furnace close the heating-chamber completely, and the work is thus protected against oxidation and scaling.

At the moment when the work is introduced into the furnace, the temperature of the latter is, say, 1400°F., but the heat-storage capacity of the furnace-walls being small compared with that of the charge, the temperatures of both thermo-couple and furnace-walls drop rapidly a few hundred degrees, the current through the heating element or resistor being shut off during this time. The result can be seen in the chart made by a curve-drawing pyrometer connected to a thermo-couple placed in a furnace operated in the manner just described, as reproduced in Fig. 1. The temperature drops rapidly from 1400°F. at A to about 870°F., and then rises slowly to B, where it is stationary, the thermo-couple, furnace-walls, and all parts, small and large, of the charge having reached approximately the same temperature. The switch is then closed, the input being so regulated that the temperature rises at the desired rate. The fact that the work and furnace start from the same temperature at B, far below the critical point, coupled with a proper arrangement of the heating element, with respect to the charge, ensures that all parts of the work will go through the critical point at the same time. This is desirable in order to avoid stresses and distortion that would follow from unequal expansion or contraction if different parts of the work passed through the transformation point at different times.

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The arrival of the work at the transformation point, C, causes an abrupt change in the rate of heating, due to the suddenly increased capacity of the steel to store heat, the temperature stops rising or proceeds much more slowly than before, although the rate of supply of heat energy has not been changed. However, once the transformation is completed, as at D, the temperature again rises rapidly. The pause is shown plainly by the hump in the curve.

Before quenching, it is necessary to heat the work for a certain time after this point, the time depending on the mass and shape of the steel, the quenching medium employed, and the qualities desired. The exact further heating to be allowed after the completion of the transformation point is learned by experience or trial, but once known, all uncertainty as to the result is practically eliminated.

In using the hump method, the metal is quenched without hesitation, as soon as the pen has gone the prescribed distance past the 'hump' indicating the transformation point. Errors caused by inaccuracy of pyrometers, non-uniform temperature in the furnace, failure of the work to reach the furnace temperature, or incorrect information regarding the transformation temperature, are avoided, and the steel is not injured by overheating or by holding it at a high temperature for too long a time. Each piece of work carried the same distance beyond the reference point, C or D, will show the same internal structure. This is true whether or not the temperature represented at the point C on the chart is correct, and whether or not it is the actual temperature of the steel at that moment. The important fact is that the chart tells the attendant when the steel is going through the transformation, from which he may know that quenching after a certain interval will secure the desired physical qualities. Furthermore, the chart remains as a record of just how each individual lot of steel was treated, and can be consulted in connection with properties developed in physical tests of that steel.

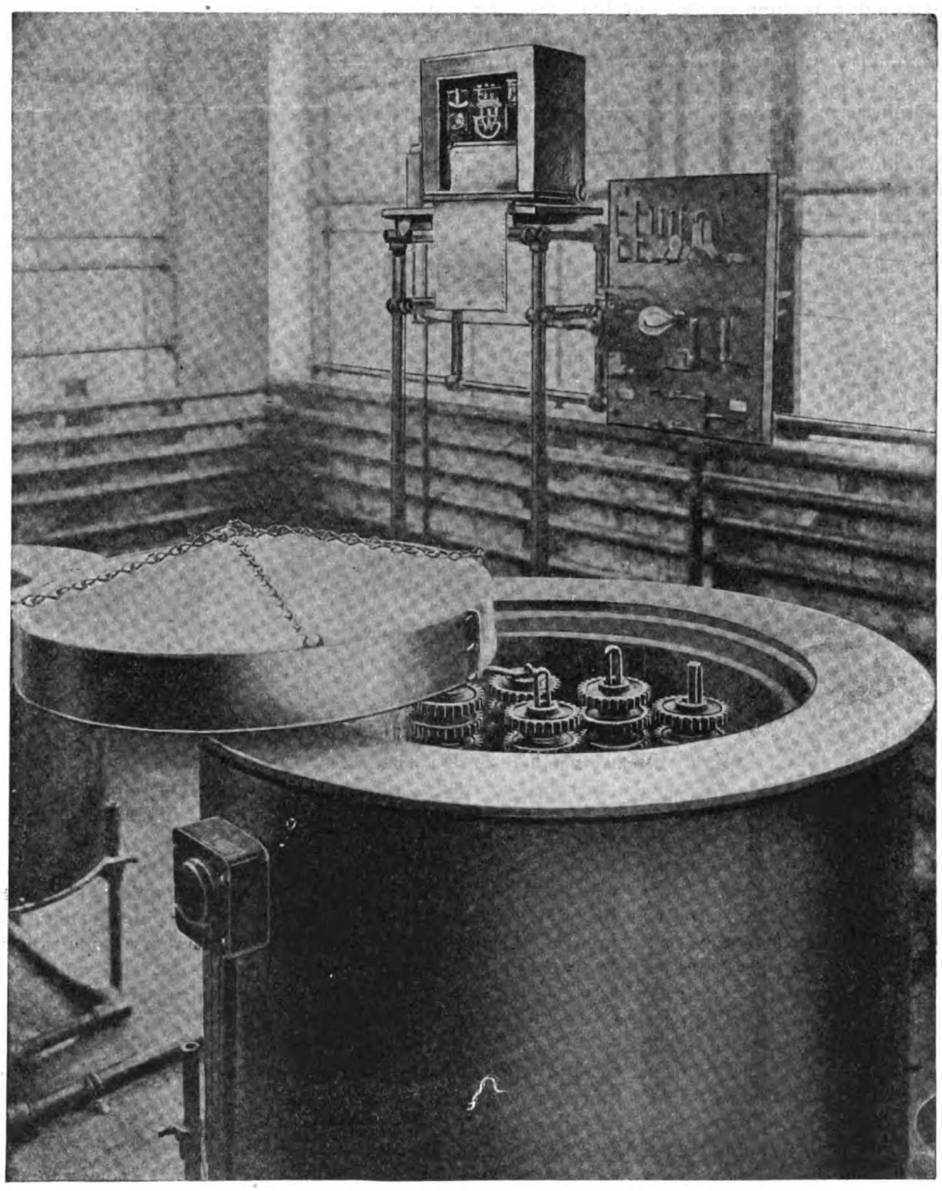

Fig. 6. Furnace for Drawing Transmission-Gears

It is found that the rate of temperature increase has a marked influence upon the properties exhibited by the steel after quenching. The resistance furnace is admirably adapted for controlling the rate of temperature rise, since the rate of energy input is easily regulated by reference to an ammeter supplied as part of the furnace equipment. The potentiometer pyrometer, Fig. 4, is likewise peculiarly suited for carrying out the hump method of heat treatment, as it is

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sensitive to small changes in thermo-couple e.m.f., and exhibits changes in rate of temperature rise upon a magnified scale. It is, in fact, the only form of pyrometer having these qualities in the desired degree.

As an example of the use of the electric furnace in hardening tools, the manner in which punches and dies are produced in a shop where this method has been used exclusively for the past six years will be described. One of these punches and dies is shown in Fig. 5. The punch is first made in the ordinary way by machining and hand finishing. It is easy to secure accuracy in the making of a punch, as all measuring and gauging is done on the outside. The die is made to approximately the correct size, but slightly smaller. The punch, having been hardened and ground to exact dimensions, is then used as a broach to cut the die. It is forced into the die a short distance, raising a burr, which is removed by filing, the operation being repeated until the cut is finished. The die is then relieved, but no further work is done on the cutting edge. After hardening the die by the hump method, the size and shape are found to be so exact with respect to the punch, that subsequent work, as stoning or grinding, is not required.

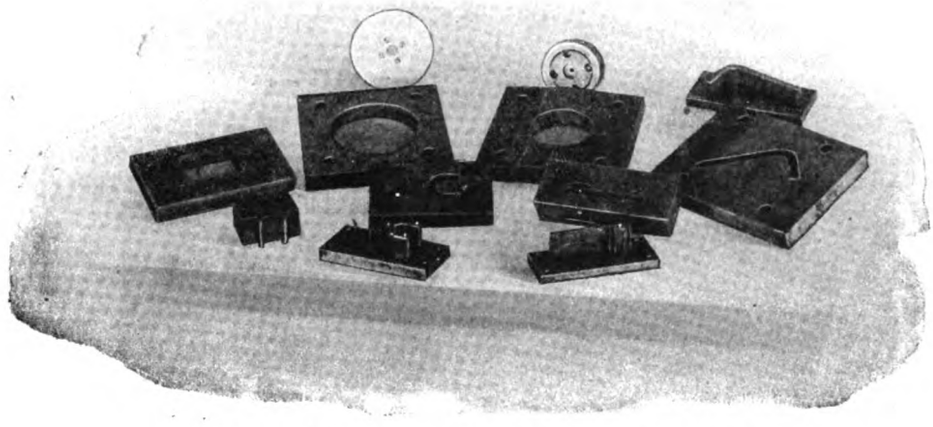

Fig. 7. Blanking Punches and Dies Hardened by 'Hump' Method

Dies that have been broached by the punch and then hardened by the hump method, are superior, for purposes where close correspondence of punch and die are necessary, to hand-made dies hardened in the ordinary manner. Hand-made dies must be corrected by hand work after hardening, and such hand work can be guided only by reference to a templet. It is practically impossible to make the templet exactly the same shape as the punch, and it is also difficult to make the die fit the templet exactly. Even on work where internal calipers or micrometers can be used, it is not practicable to make a die exactly the same shape and size as the punch, as any hand work is necessarily more or less irregular.

The fact that dies hardened by the hump method fit exactly with the punches by which they are broached, shows that there has been no volume change or distortion during the process of hardening. It has been found, however, that the previous history of the material, the rate of heating, and the interval which is allowed to elapse between the transformation point and the quenching point have certain relations to volume changes which are of great importance in the hardening of such objects as dies, milling-cutters, and gears.

Production operations are simplified by the use of electric heat-treating furnaces with the hump method. As an example refer to Fig. 6. Formerly in this plant automobile transmission gears were heated for hardening in lead pots placed in the basement beneath the machine-shop. After the gears had been machined, they were removed on trucks to an elevator, lowered to the heat-treating room, an uncomfortable place because of heat and fumes, and wheeled to the lead pots. The gears were placed in the lead pots in batches, and when they had come up to temperature, were lifted out one at a time, and dropped into the oil-quenching bath. The time of heating in the lead pots was thus not the same for all pieces, and the temperature also varied with the position in the pot, possibly causing non-uniform hardness and grain structure. The gears were also sometimes injured by dropping upon one another in the quenching-tank. The drawing was done in gas furnaces, followed by an oil quench. Upon their return to the machine-shop, the gears were wire-brushed to remove adhering lead.

The electric-furnace equipment replacing the lead pots and gas furnace is situated in the machine-shop itself. There are six electric hardening-furnaces placed on two sides about a quenching-tank, with three electric annealing-furnaces on the remaining side, also a drain-grid and a cleansing-bath between the quenching-tank and the annealing-furnaces. The tops of all furnaces and tanks are flush with an elevated platform. The work is brought on trucks to the edge of the platform, where a boy arranges the gears upon holders, which are easily picked up by the operator, and upon which the gears remain until they have passed in turn through hardening-furnace, quenching-tank, cleansing-bath, and drawing-furnace. Corresponding to each hardening-furnace, there is a curve-drawing recorder, and for each drawing furnace an automatic temperature-recording controller, all mounted upon a wall near by, where also are the furnace-rheostats. An assistant foreman on duty at this point directs the operations according to the indications of the curve-drawing recorders connected to the hardening-furnaces.

The amount of electrical energy consumed by the electric furnace is comparatively small, because of the efficient insulation. There is no loss of heat in waste gases, as with combustion furnaces, leaving to be supplied only the heat imparted to the work. The higher cost of electrical energy is more than repaid by the saving in necessary apparatus, such as pumps, blowers, and burners, and the labor costs, as the electric furnace can be placed in the machine-shop in the direct line of manufacture, thus saving the double handling of the work which is necessary where it must be taken from the machine-shop to a hardening room and then back again.

The use of the hump method in regular manufacturing gives a higher grade, a more uniform output, and simplifies handling and cleaning to such an extent as to render the cost

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of electrical energy of minor importance. Dependable results and large volume of output are obtained with regularity and certainty, and without requiring a large number of skilled men.

Where electric furnaces are used in the tool-room, the tool-maker can be closely in contact with the hardener, so that methods of operation in tool making, which often increase the difficulties of the hardener, can be avoided, while

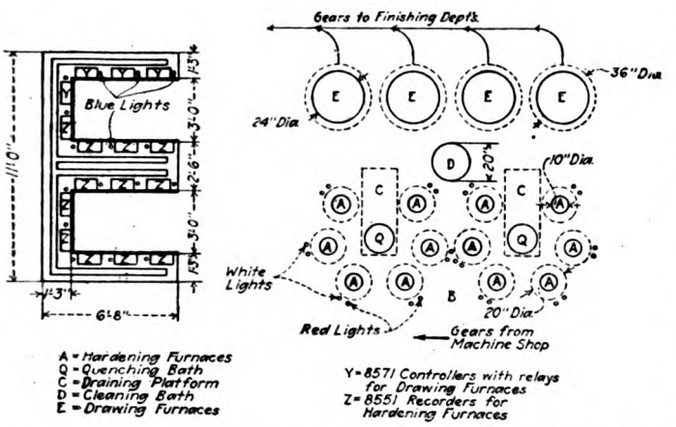


Fig. 8. Lay-out of Furnaces and Recorders for Treating Gears by the 'Hump' Method, Also Drawing-Furnaces

through the use of the hump method it is sometimes possible to simplify the work of the tool-maker as related in connection with die making.

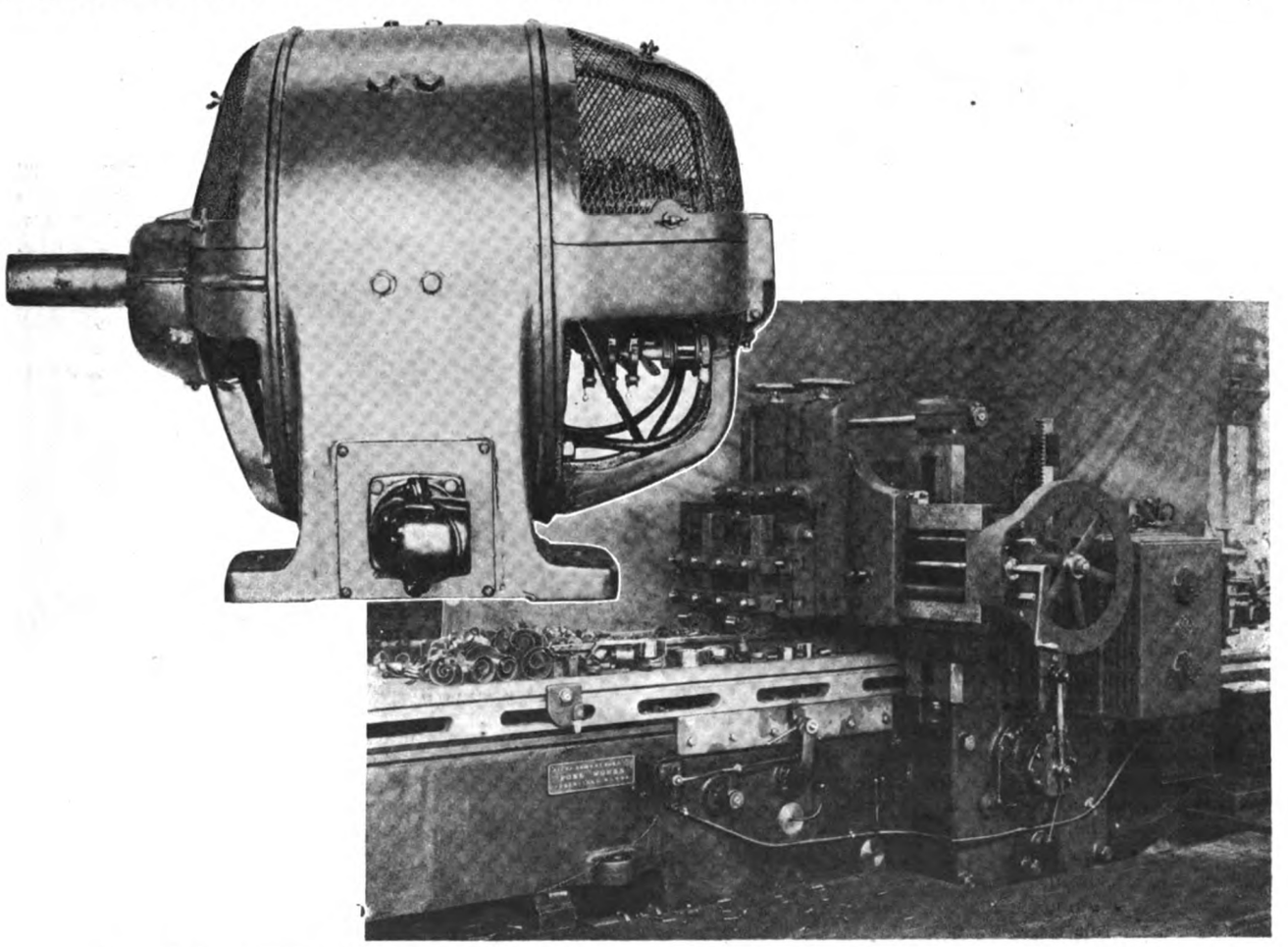
The hump method of heat treatment is controlled by the Leeds & Northrup Co., of Philadelphia, which company also manufactures the electric furnaces and curve-drawing pyrometers used in carrying out the process. Hump method equipments for hardening tools and dies have been installed by such concerns as the Ingersoll-Rand Co., the Miller Lock Co., the Westinghouse Electric & Manufacturing Co., and the Standard Tool Co., while equipments for large-scale commercial production are used by the manufacturers of the Packard, Hudson, Dort, and Nash automobiles, by the Detroit Gear & Machine Co. and Brown Lipe Gear Co., and by other well-known concerns in the automobile field.

REVERSING DRIVE FOR PLANERS AND SLOTTERS

Perhaps the most interesting motor application to machine-tools from the standpoint of production, is found in the rapid-cycle reversing equipments, as applied to planers, slotters, and similar machines. The adjustable-speed motor and control manufactured by the General Electric Co. ensures reliable equipment, requiring minimum attention. Belt troubles become a thing of the past.

For this service, the motors used are what is known as the RF type. Perforated-top half-enclosing covers are furnished. No motor base is included. The speed used, and recognized as standard by practically all planer manufacturers, is 250 to 1000 r.p.m. Of this range the first half, 250 to 500 r.p.m., is used for the cutting direction, and the high end, 500 to 1000 r.p.m., for the return. In addition to an interpole or commutating winding there is a set of coils, known as the compensating winding. These coils are placed and proportioned to neutralize the armature reaction inherent in direct-current motors.

Control for this service, to be satisfactory, must positively make and break the several circuits during the continuous



Planer Equipped with Reversing-Drive Motor Planing Railroad-Track Special. Above, General Electric Adjustable-Speed Motor

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operation obtained. The equipment furnished consists of enclosed panels, either walls or floor mounting type. With the wall-type, the starting and braking resistors are separate, being mounted in a ventilated support. The number of boxes required depends on the horse-power of the equipment. The floor-mounted or pedestal-type, has the resistors mounted on the back of the panel and contained within the enclosing case. Ventilation is provided through the cover on the back, which is made of expanded metal. Excepting the resistor, the accessories for either panel are the same. These consist of a transfer-switch, master-switch, and push-button station that can be mounted as a pendant.

Much has been said and written regarding the increased production and saving in power due to applying power direct to the machine-tool, yet it is doubtful if anything like the real importance of this direct application of power is realized. The saving of power is looked upon generally as a matter of how much of the transmission-friction load can be saved, and though this is sometimes quite an item, it is often only a small part of the real saving, as proved by numerous operative tests.

Belt-driven planers show a wide variation in power consumption because of the several variables encountered, such as tight belts and different weights of pulleys of the same diameter, with the consequent change in fly-wheel or momentum effect. Loose or light belts will show excessive slipping on reversals, and when making average cuts. Medium or large-size reversing pulleys of average speed, unless extremely light, will show high power-peaks, sluggish reversals, and will be slow in accelerating. Double-belt drives will show heavy power on accelerating to high speeds and high on reversing to cut, not unlike those of the high-speed pneumatic clutch.

Tight belts will generally cause high peak-loads on reversals, but they reverse faster, pull heavier cuts, and wear out quicker than moderately tight belts, but the latter, due to slip, retard production. The direct-connected reversing motor eliminates these undesirable conditions and there is a noticeable increase in strokes per given period of time. This means increased production and, in addition, power is saved.

The majority of planers today return at a speed of approximately three times the cut, therefore the greatest amount of time is saved when a maximum cutting-speed can be obtained. As an illustration, take a cutting-speed of 25 ft. per minute and a return speed of 85 ft. By increasing the cutting speed to 35 ft. per minute and maintaining the same return, there will be a gain of about 22% in time on the whole cycle. On the other hand, increasing the return speed by 10 ft. and maintaining the cut at 25 ft. per minute produces a gain of only about 2.4% in time. The foregoing clearly shows the great advantage of using the direct-connected reversing-equipment, where the cutting speed can be adjusted to the maximum. In addition, this speed will be maintained for all loads within the limit of the motor.

In general, the reversing motor for planer-drive, or when used on any machine requiring this type of drive, allows an adjustment of cutting and return speeds to obtain the greatest number of strokes per unit of time, and eliminates all slip, except the amount inherent in any energy transforming machine (except those compensated by special devices) and which, with mechanical drive, has to be added to the slip of these mechanical parts. Special machines requiring a motor-reversal as frequent as once each second are being successfully driven with this type of motor.

While the foregoing has been written with the planer in mind, it is also applicable to any machine-tool requiring a fast-cycle reversing-equipment. Screw, worm, and rack-driven slotters, key-seaters, turret-lathes, wire and tube-drawing machines, and boring-mills (when used on certain work) may be equipped with this type of motor and control.

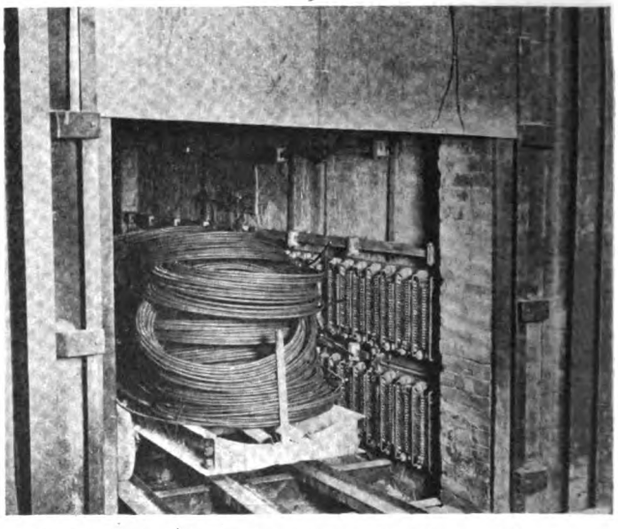
When attaching reversing-motors and control to old planers in the majority of cases, the driving-shaft of the planer will be slow enough in speed on the slowest cut to meet a motor-speed of approximately 250 r.p.m., in which case only a coupling and the necessary motor foundations will be required, in order to attach the motor. If, however, the planer-gearing is of such a ratio that the speed of the driving-shaft, corresponding to the slowest cut required, is slower than the motor speed (250 r.p.m.) it will then be necessary either to use a slower-speed motor, which is expensive and undesirable for many reasons, or to provide an additional pinion and gear for the required speed-reduction. When the motor is driving through a pinion an outboard bearing should be used. This can be accomplished either by motor-shaft extension, or, if a standard motor-shaft be used, by a special pinion with extension for outboard bearing. Where the motor is coupled direct to a planer-shaft which is driving through bevel or worm-gearing, means should be taken not to throw the thrust on the motor-bearing. The coupling between motor and machine should be as small in diameter as is consistent with good practice.

All parts connected to or operated by the rocker-arm should be kept as light as possible, since excessive or unbalanced weight sometimes causes the rocker-arm to rebound to the off position.

ELECTRIC-HEATED OVEN FOR BAKING WIRE

In the manufacture of steel wire the rods as received from the hot rolls are pickled in acid to remove the scale, dipped in lime-water to neutralize the excess acid, and then baked, the amount of baking depending on how small the wire is to be drawn. If it is to be drawn only one or two holes, a short baking-period is enough, but for five or six holes the stock must be baked for several hours to withstand the severe drawing. The wire may also be heated to dry off grease or oil, or for a low anneal.

At the plant of the Halcomb Steel Co., at Syracuse, where



Interior of Wire-Baking Oven Showing Heating-Unit

the following operation figures were obtained, there are two electric drying-ovens, using General Electric Co. apparatus, one 6 by 6 by 16 ft., with 96 kw. connected, used for drying the wire, at a maximum temperature of 600°F., the other 6 by 6 by 40 ft. with 234 kw. connected, for drying 'acid in the steel', the wire being in the oven from one to ten hours at an average temperature of 350°F. Coke and steam-heated ovens are also used to do the same work, thus it is possible to obtain comparative operation costs.

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In spite of the fact that the cost of electric power is higher than the fuel cost for similar ovens, when the total cost of operating the ovens was considered, the electric oven was found to be considerably more economical.

These figures take no account of the improvement and the duplication of results in the finished product because of temperature control, whereby the operating temperature can be changed quickly when desired. Nor do they take into account the elimination of delays caused by either the difficulty of obtaining coke at the ovens, or by the greater time required to heat the coke-fired ovens.

This particular plant is operated on a quality basis, therefore speed is of secondary importance. However, should speed of operation become the first consideration, the electric oven would still be preferable, since the uniform distribution of heat gives a rapid rise to maximum heat, and the perfect control of temperature makes it possible to maintain the maximum temperature without danger of overheating. The use of electric heat has not only increased the capacity of the ovens, but also produces finished work with no rejections.

INGERSOLL CONTINUOUS MILLING MACHINES

The continuous type of milling machines have, during the past few years, received considerable attention from those interested in quantity production. As the name implies, these machines make possible the performing of duplicate operations without loss of time for loading and unloading fixtures. Only those milling machines that do not permit the operator delaying the cycle of work, either through control of the feed or the spacing of fixtures, are truly continuous. An important feature of these machines is the small amount of floor-space required. Another is ease of operation, with consequent low labor-cost, for, while this type of tool provides continuous work for the operator, it is not exacting work, and can be performed throughout the day without calling for undue exertion.

Continuous milling machines are particularly adapted to quantity production. Their great value is lost if their work does not consist of milling duplicate operations. While their fixtures can be changed for fixtures handling different work, this is seldom good practice, unless the operations are similar. In fact such machines are not general-purpose tools, but are adapted rather to special conditions.

Fig. 1 shows a differential-type continuous machine with a 60-in. table with an upper member equipped with four spindles, milling the cylinder-head contact-surface of a motor-casting. The loading-station is shown empty. Both the upper member and the table rotate continuously in the same direction, the table being driven at a higher rate of speed. They are driven by worm-gearing, which is arranged so that as soon as a roughing and a finishing cut has been taken over the first casting loaded, it reaches the station in front of the operator with both operations complete and no cutters in contact with it, so that it can be unloaded and replaced with a rough casting. Conveyors to and from the machine may be arranged at the level of the fixture-plate so as to make the operator's work relatively easy. He has only to unlock the casting from the fixture, slide it on the conveyor, and slide a rough casting from the other conveyor to the fixture. Since the machine is working continuously and taking both roughing and finishing cuts, the output is at a maximum.

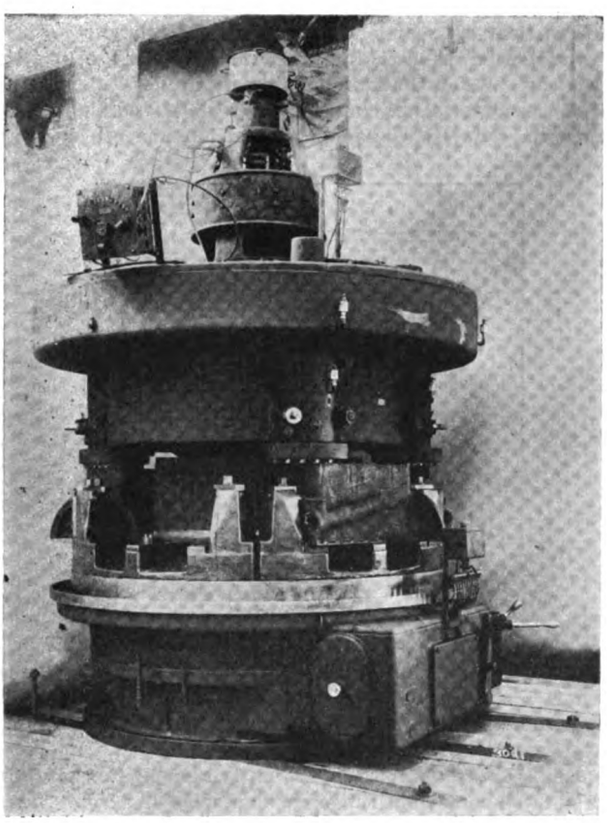

Fig. 1. Differential Type Continuous Milling Machine

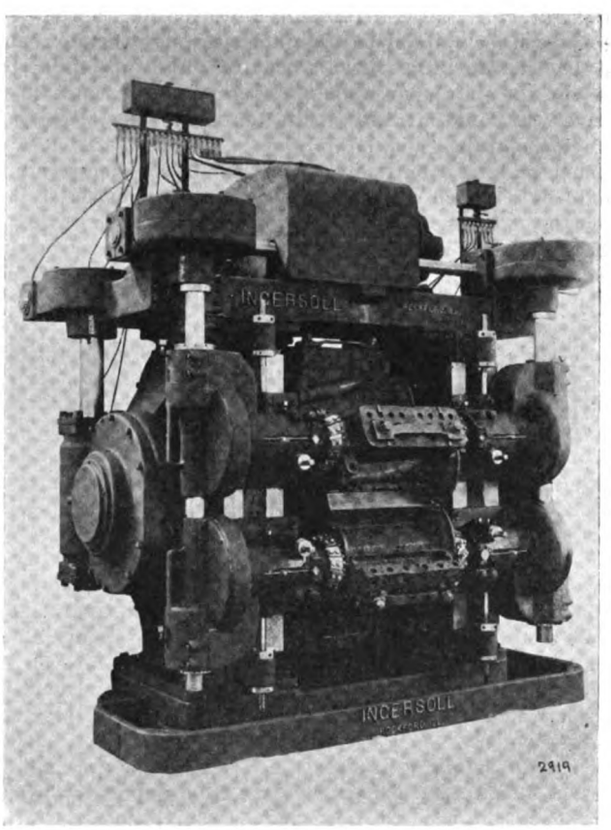

Fig. 2. Drum-Type Continuous Milling Machine

The drum type of machine is shown in Fig. 2. The drum, which corresponds to the table, holds the castings and revolves past the spindle-heads, which are mounted on the housings on each side of it. In the particular machine shown there are two sets of heads, the upper ones carrying roughing cutters and the lower ones finishing cutters. The operator stands at the rear of the machines, and as the drum

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revolves upward past him, removes the finished castings and replaces them with rough castings. The machine is milling the ends of the same motor castings shown in Fig. 1, and is producing a finished casting every two minutes, day in and day out. The castings are machined to limits of 0.002 in. for both squareness and parallelism.

Other types of continuous machines are based on the principle of a revolving table turning beneath a column that contains fixed spindle-heads, and the company also manufactures a continuous reciprocating machine.

LEAD-BURNING*

Lead-burning is the autogenous welding of lead with a gas torch. The edges of the lead parts are fused together, using no solder or other metal except pure lead to fill the joint. The term 'lead-burning' is a misnomer as the metal is not burned but simply fused together. The process is used for applying the lead linings of acid-tanks used in chemical plants, fertilizer factories, rubber-reclaiming works, electroplating shops, nitro-glycerine huts, and other industries. The widespread use of electric storage-battery starting-systems on motor cars has created a demand in garages and battery-service stations for lead-burning equipment for welding the lead connectors and terminals. Lead-burning is used to some extent in making lead-pipe connections, but the principal field is in tank and storage-battery work.

Considerable skill is required of a lead-burner to weld lead sheets together without burning holes through them or causing the lead to drop. Two forms of joints are used, the butt and the simple-lap seam. The latter is used almost exclusively in tank-burning. Butt joints are used mostly in lead-pipe jointing.

When making a butt joint the edges of the sheets or pipe should be trimmed straight and they may be rasped so that when the two sheets are laid together a V-groove of 30° or slightly less is formed, if filler is to be used. The groove is filled with molten lead, flush or slightly above the surface of the sheets or pipe.

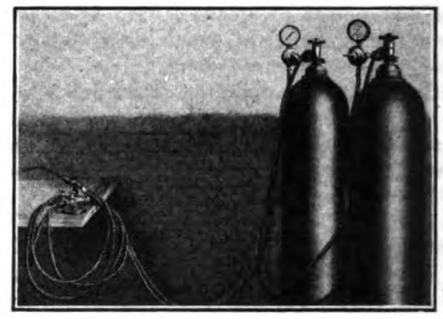
Preparing the butt joint by beveling the edges is not practised for sheet burning except on heavy lead—so thick, in fact, that it is rarely used. All thicknesses up to, say, 20 lb. to the square foot are butted with square edges and generally are burned together without using a filler-rod. The use of a filler-rod retards the work on account of the necessity of frequently cleaning the oxide film from the stick. A joint made without filler-rod is slightly thinner than the sheet but this is rarely objectionable.

When burning a butt joint with a filler-rod the flame is played on the edges of the sheets until the metal is softened to the fusing-point but still is too stiff to flow freely. The added metal is supplied from the lead filler-rod or solder-stick. The solder-stick is held in the left hand close to the joint and so that the heat of the flame melts it and deposits molten lead into the joint the same as in soldering a tin joint.

It should be borne in mind that tank linings are made of 'chemical' lead, that is, new lead free from impurities. Ordinary sheet lead used for gutters and other purposes is often made from old lead, and should not be used for acid-tank linings that must be autogenously welded.

Lap seams are used in tank linings whenever a smooth surface is not absolutely required. In making a lap-seam the top sheet should lap over the under sheet ½ to ⅝ in. Dirt and oxide should be removed from the joint with a sharp scraper. Some lead-burners prepare for welding by painting a strip of asphaltum about one inch wide along the edge, letting it dry, and then scraping a strip about ½ in. wide next to the edge with a sharp scraper, which removes the oxide with the asphaltum. The asphaltum tends to hold the lead from breaking down when overheated, and thus favors using a large flame and burning at a fast rate.

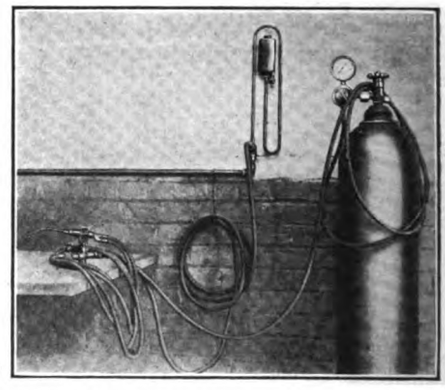
The flame is directed against the top sheet about ¼ in. from the edge. Some burners give the torch a circular motion, the diameter of the circular path being from ½ to ⅝ in., but the most rapid work on level seams is done with a straight movement only. The top sheet fuses and unites



Davis-Bournonville Lead-Burning Outfit with Hydrogen and Oxygen Cylinders

with the metal beneath and the edge breaks down and the corner is filled with molten lead, which adheres to the lower sheet, making a weld about ⅜ in. wide. A filler-rod is not needed.

On vertical lap-seams the torch is generally given an in-and-out motion, thus taking the flame close to the lead and then away. When the flame is close to the lead a small section of the upper sheet over the seam melts and slides down about ¼ in., where it cools and unites. The repetition of the



Lead-Burners' Torch, Bench-Control, City-Gas Connection, and Oxygen Cylinder

torch movement causes this action to be repeated, drops of molten lead sliding down the joint and uniting each time the torch is held close. This method is used only on vertical work, where it is not feasible to do straight-away burning.

The temperature needed for lead-burning is about 625°F. A special torch is employed, which is held in the hand and manipulated somewhat the same as a soldering iron. Davis-Bournonville Lead Burner's torches may be used with either hydrogen, acetylene, or city gas as the combustible elements, and compressed air or oxygen to maintain combustion. It was formerly believed by lead-burners that hydrogen only could be successfully used but this belief has been disproved.

Hydrogen produced in the generator commonly used by lead-burners is poisonous unless purified. The reaction of sulphuric acid with iron or zinc produces impure gas and it should be passed through a purifier, but in many cases this is not provided, the result being that the lead-burner is likely to be poisoned with the fumes, especially when working in confined places. Acetylene generated on the spot with the best apparatus or furnished in cylinders dissolved in acetone

*Abstract from 'Autogenous Welding'.

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is free from poisonous impurities and may be safely used where the generated hydrogen would quickly affect the health. Hydrogen furnished in cylinders is also pure and safe to use.

The lead-burner necessarily becomes expert at working lead within narrow temperature ranges. He must heat the metal at the joint to the fusing-point but not so much that it becomes liquid and drops away. He should also make provision for growth or expansion of the linings of hot tanks. Repeated heating and cooling causes the lead to expand, and after a period of use the lining will be corrugated because of the permanent expansion.

Lead-burning of storage-battery connections is comparatively easy. The danger to be avoided is overheating. The operator must learn to clean thoroughly the parts to be united and to apply the flame no longer than is required to fuse the metal, and bring about union. When the connections have been flowed together the excess metal should be wiped off with a woolen cloth greased with mutton-fat or beef-tallow.

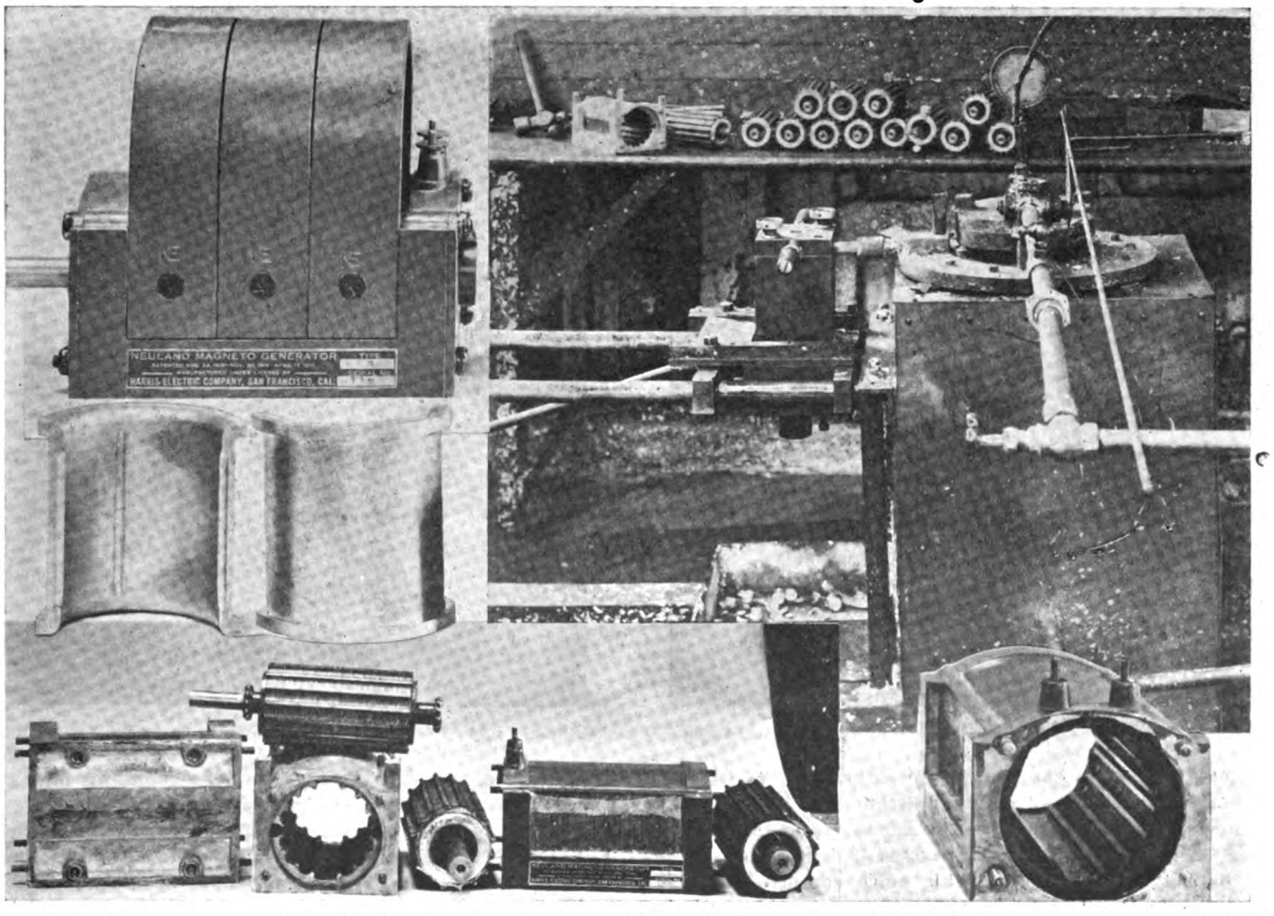
LOCAL CONCERN SUCCESSFUL IN MAKING DIE-CASTINGS

The accompanying illustrations show the Neuland magneto generator, which is made by the Bushnell Manufacturing Co. of Berkeley for a San Francisco electrical concern, also certain features of the manufacture of the device. The most important feature of the manufacturing process is the use of die-casting for most of the work. Three die-castings are made: the rotor, the body, and the end-plates. The rotor consists of 375 steel laminations cast on a steel shaft. These parts and the necessary cores are assembled in the die. The air is exhausted from the mold and the metal poured under high pressure. This use of a vacuum prevents air-bubbles being caught because of the irregularities of the mold and held by the flowing metal, causing blow-holes or spongy spots in the finished casting.

The body for the generator includes 700 steel laminations together with four bolts for holding the end-plates. These are also assembled in the die with the necessary cores. This casting, which is 6½ in. and weighs 10 lb., is cast with an accuracy of 0.0015 in. Smaller pieces with no inserts can be cast with an accuracy of 0.0005 inch.

For repetition work on relatively small parts, such as those described, the advantages to be gained from die-casting as compared with other methods are lower cost, greater output, and greater accuracy. An example of the saving obtained both in time and in money is given by the end-plate for the generator. These plates were formerly machined brass-castings. One man finished six per day on an engine-lathe at a cost of $2.25 each. Now they are made from a cheaper zinc-base metal at the rate of 300 per day, requiring no machining, and costing $0.60 each.

The Bushnell company has done a general machine-shop business for several years, which it still continues, but, since the first of the year, the owners have been specializing on die-casting. A staff of men experienced in this class of work has been engaged and additional die-casting machines and furnaces are under construction. The company is equipped for making die-castings from either zinc-base or tin-base metals. The melting-furnaces are gas-fired, as this gives better control than when other kinds of fuel are used. The cost of gas is about $20 per month, which is nominal, considering the amount of work done. The company maintains a toolroom for the design and manufacture of dies for the work.



Upper Right, Die-Casting Furnace, Rotors for Generator in Rear. Lower Right, Body of Generator. Lower Left, Generator Parts. Upper Left, the Completed Generator. Below it Are the Two Halves of a Die- Cast Bearing, Requiring No Machining. Note the Oil-Groove.

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THE BEST-EQUIPPED TELEGRAPH OFFICES IN THE WORLD

There are few if any manufacturing corporations in the San Francisco Bay district that turn out 2,500,000 completed articles in the course of a month, or that have been able in spite of the present so-called inefficiency of labor to make a reduction of over 30% in their manufacturing time per unit during the past few months, until now completed articles are made from the raw material in an average of six to seven minutes. Yet this is what the Western Union Telegraph Co. is doing at its main San Francisco offices with the telegrams that are its product.

To make these results possible, the company has recently completed extensive changes in the equipment of its main offices at 722 Market street, San Francisco. These offices are now the best-equipped in the world, and are the third largest in point of business transacted in the United States. The district controlled from this office comprises roughly all the Pacific Coast and Intermountain States. All cities of importance within this district have their individual wire outlets to the East, North, and South, but the San Francisco office is the relay centre for a small surrounding district in northern California, besides being the hub of a flexible system of wire interconnections, which is designed to meet the emergencies of storms or sudden and unusual traffic demands such as a national political convention.

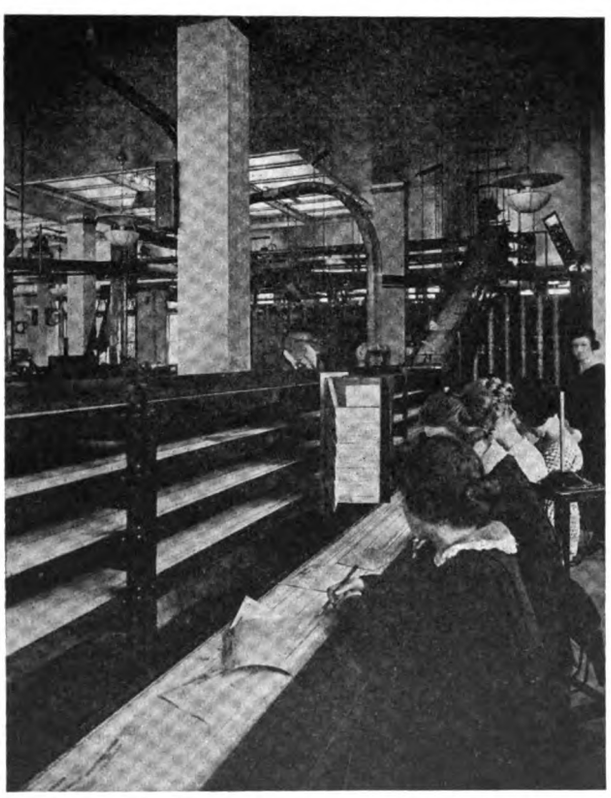

Fig. 1. Belt-Conveyors at Distributing Centre in Operating-Room

The general course of a message through the office is as follows: If it is received at a branch office it is generally telephoned in to the main office at the present time. This, however, will soon be changed, as pneumatic tubes are being laid connecting all the downtown offices. Copper tubing in creosoted-wood ducts is laid in the streets, while the risers within the buildings are of steel. In all, eleven miles of copper and two miles of steel tubing will be required. Messages brought in by messenger or filed at the business counter are shot up to the operating-room by pneumatic tubes; and a staff of telephone operators, or 'recorders', receive messages by telephone from the public. At present, 65% of all messages are handled by the automatic-instrument operators, and 35% by Morse operators.

Fig. 2. Part of Operating-Room

The automatic instrument, the Western Union multiplex, is such a remarkable device as to call for further explana-

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tion. The transmitting instrument has a keyboard and is operated like a typewriter but instead of printing letters, it makes perforations in a strip of paper resembling a piano-player roll, except that it is only half an inch wide. This tape feeds into the other part of the transmitting instrument, and releases a series of electrical impulses so that at the other end of the wire selector-devices in a receiving typewriter are actuated, and the messages are automatically transcribed at high speed. The mechanism is so synchronized that eight messages can be transmitted over the same wire at one time.

Belt-conveyors run in front of every operator, both those receiving and those sending, and convey every message entering the room to the distributing centre shown in Fig. 1. All messages received, whether by automatic, Morse, or telephone, pass on the lower conveyor in front of the line of girls shown in Fig. 1, who sort the messages and place them on one or another of the upper conveyors, according to the destination. From here the messages pass to the transmitting operators. The maximum time in transit for messages around the room is 59 seconds, with an average of 21 seconds. As already mentioned, the average time from the receipt of a message at any office in the district until it is ready for delivery at the office of destination has been reduced during the past few months from between ten and twelve minutes to between six and seven minutes. Over 90% of the 2,500,000 messages pass through the finished handling within the time limit of ten minutes after they are received.

Few companies, whether their product be commodities or service, have carried standardization as far as the Western Union company. All printed forms are standard for the entire country, as well as other office equipment. The same is true of field equipment. Practice has also been standardized and written instructions prepared for all classes of positions, following study and conferences between all those qualified to give advice. At the same time, individual initiative is not only given free play but encouraged. Whenever an employee, from messenger up, does something worthy of commendation, whether in obtaining business for the company or in any other way, he is commended and the other employees through the district know of this commendation. A large part of the time of the various managers is devoted to passing on suggestions received from employees. Every suggestion receives careful consideration, and if it is found to be impractical, the reasons why are explained to the man making it, so that he is encouraged to try again. The entire company is on a profit-sharing basis. All profits over a specified rate of interest on capital are divided equally between the stockholders on the one hand and the 60,000 employees on the other.

Space does not permit more than an allusion to many other interesting features of the new offices, such as the school for training multiplex and telephone operators, the rest-rooms for both male and female employees, and the tailor-shop where messengers' uniforms are not only furnished but are kept in order at a total charge of 40 cents per week. By the way, the messengers are all on 'piecework' and some of them make as much as $200 per month.

The growth of business in the San Francisco office is indicated by the increase in the number of messages handled, from 900,000 per month during 1913 to approximately 2,500,000 per month at the present time. This growth may be taken as indicating a similar increase in business activity in all lines of trade and industry.

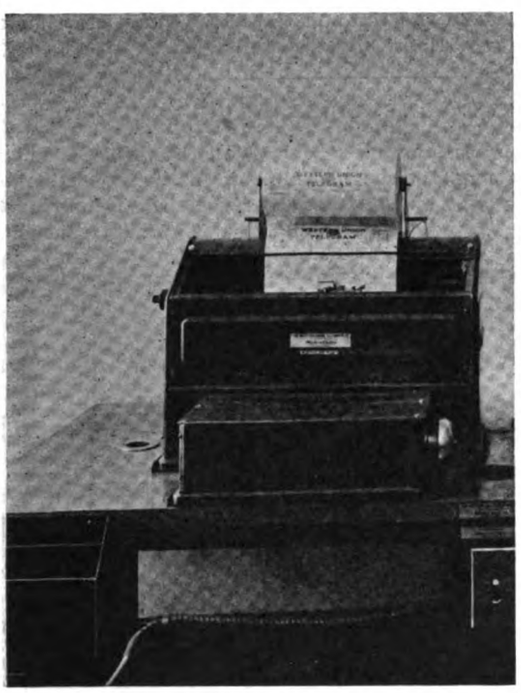

Fig. 3. Receiving Typewriter for Automatic Instrument

Fig. 4. Typewriter and Other Parts of Transmitting Device for Automatic Instrument

STRAUB ACETYLENE GENERATOR

The Pioneer Welding & Radiator Works, 22 Ninth street, San Francisco, is equipped with two Straub acetylene generators. One is a stationary generator and supplies the shop, while the other is used on outside jobs, being mounted on a trailer, which is hauled behind the service-truck. Mr. Hartman, the proprietor, states that by the use of the generator a saving of 50 to 55% in the cost of gas is effected. Aside from the direct saving, he states that he gets better service from the generator, as it never fails, and he has had difficulty sometimes in getting filled containers when needed. Gas in the tank is at a pressure of 18 lb., which is considerably safer than the 280 lb. in the container. A further advantage of the generator over the container, according to Mr. Hartman, is in the quality of the gas. He states that welds made with generator-gas are much softer and easier to machine. The gas from the con-

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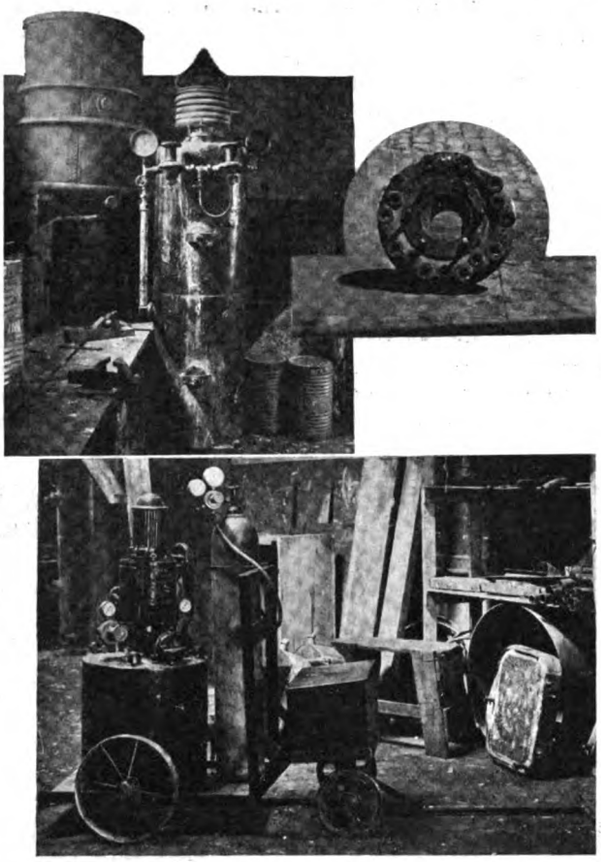
tainers sometimes carries over acetone, producing a hard metal in the weld, which is difficult to machine. Since



Upper Left, Stationary Apparatus. Below, Portable Generator Mounted on Truck. Upper Right, Specimen of Work Done

using the generator he has had no difficulty from hard spots in his welds. Mr. Hartman has been in the welding business for 17 years, and now does a general automobile and heavy welding business.

ACCIDENTS IN THE METAL-PRODUCTS INDUSTRY IN PENNSYLVANIA

A recent bulletin of the Department of Labor and Industry of the State of Pennsylvania gives to the metal and metal-products industry the distinction of having the greatest number of accidents during 1918. The report for that year follows:

	All industries	Metal and metal products
All accidents	184,844	57,134
Fatal	3,403	557
Serious	53,783	15,091
Minor	127,658	41,468
Due to lack of safeguards	10,512	6,108
Days lost	2,767,471	789,517
Wages lost	$10,286,872	$3,164,629

It has been estimated that even including minor injuries, the total injuries to the members of the American military forces during the recent war both from accidents and battle casualties did not exceed 500,000. If data from all States were available on the basis of the above table the total would be far in excess of the battle casualties of the American forces during the War. These are industrial accidents alone, whereas accidents are by no means confined to industrial life. It is estimated that 28% of all accidents occur in the home.

There are two ways of reducing the number of accidents in industry. One is by the multiplication of mechanical safeguards. But suppose these safeguards to be 100% efficient: you still have reduced the total number of accidents by only 10%. There remains, therefore, efficient First Aid instruction. Tne experience of the American Red Cross has demonstrated that the accident rate among men who have had First Aid instruction is 75% less than among the uninstructed. Not only would the accidents be fewer, but what is a still more important result of this instruction, the injured men would be put into the doctor's hands in the best possible condition, and thus wage and time losses would be greatly reduced.

The Red Cross offers its First Aid course to any group of persons anywhere in the country who care to take it. It has already instructed over 500,000 railroad employees, besides many thousands in other industries. Information concerning this course can be had from the local Red Cross chapter. There is no doubt that universal training in First Aid would reduce the present toll of death and suffering from accidents in the United States to a small fraction of its present proportions.

THE VAN NIEL BRASS FOUNDRY

The new brass foundry of Karel Van Niel, 2319 Clement avenue, Alameda, is a modern shop in every particular. The building is 50 by 100 ft. and is served by a 5-ton traveling crane. The equipment includes a Schwartz furnace, a

Above, Interior of Foundry. Below, Exterior of Same. At Right, Schwartz Furnace

Blystone sand-mixer, a Wadsworth core-machine, and the usual core-oven, sprue-cutters, grinders, and small tools. Mr. Van Niel has been in the brass foundry business for 25 years. Previous to opening his own shop he was the superintendent of the brass foundry of the Dow Pump & Diesel Engine Co., where, during the War, six to eight tons of brass castings were made daily under his direction for the Navy and the Emergency Fleet Corporation. The work in the new foundry is done under his personal supervision, and he is prepared to turn out brass, bronze, aluminum, or gunmetal castings ranging in weight from one pound to one ton. Particular attention is paid to work made from metal of special analysis.

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A PRACTICAL SAFETY DEVICE

Emery-wheels, rotary cutting-machines, and similar tools are a constant source of danger to the workman's eyes. With 'safety first' being preached by trained organizations in all big industrial establishments, any device designed to protect the worker's eyes from injury is of general interest. Goggles and glass shields have proved fairly satisfactory, but not entirely so because of the likelihood of the glass becoming broken. Recently safety glass and transparent sheeting (the same material used for lights in automobile curtains) have been tried with success. The safety glass is made either by laying in it a coarse mesh of fine wire, or by employing hydraulic pressure to weld a piece of the transparent sheeting between two sheets of glass. However, for goggles or shields over emery-wheels the transparent sheeting alone is effective. It is cheaper and lighter than any form of glass. Fire-glass, (having the wire in it) safety glass, or the transparent sheeting alone can be fitted in an oblong frame to be imposed over the wheel in such a position as to deflect emery dust and metal particles from the operator's eyes. The fire-glass is not suitable for goggles, but the safety glass or the sheeting alone is suitable for the purpose.

DUPLICATE OF EXPRESS RECEIPTS REQUIRED

On and after July 1, the American Railway Express Co. will keep a duplicate copy of every receipt it issues when receiving business from shippers. The duplicates will be retained by the express company for the purposes of record and reference, and will be held at the shipping office. Shippers who have been accustomed to prepare their own receipts or who have their own forms have been requested to make provision for supplying duplicates of such receipts to the express-driver or receiving-clerk who signs them. As a matter of convenience to shippers, the regular receipt forms of the express-carrier will be revised to permit their use in duplicate form.

Where prepaid receipts are now being issued in duplicate, the extra copy being used as a record of charges paid, a third copy will be required under the new system, and in such instances prepaid receipts will be issued in triplicate. One of the objects of the new system is to bring about better protection for and methods of recording the movement of express packages in transit.

CONVENTION OF THE INDUSTRIAL RELATIONS ASSOCIATION OF AMERICA

The second annual convention of the Industrial Relations Association of America was held in the Auditorium Theatre, Chicago, May 19 to 21. This association, which was first organized in 1918, is composed of those in charge of the employment, personnel, and industrial relations work in industrial and mercantile enterprises, as well as executives and others interested in the relations between employer and employee. The original name of the organization was the National Association of Employment Managers, but the broadening of the scope of the society led to the adoption of the present name in January 1920. The purpose of the association is to assist its members in selecting, placing, and training employees, by keeping them informed of the best experiences, theory, and literature in employment and personal lines through conventions, conferences, committee studies, reports, and other literature. No attempt is made to enforce standards or policies upon any of the members, the endeavor being to educate through the presentation of the experiences of others in such form as to allow the selection of methods best fitted to a particular concern or industry.

Some of the subjects discussed at the recent convention were as follows: Americanization; Shop and Works Committees; Industrial Relations Department Costs; Insurance and Bonus Plans; Job Specification and Job Analysis; Employment Office Methods; Incentive and Production; Community Conditions Affecting Labor Stability; Public Opinion and Labor Policies; Wage Levels; Radicalism; Apprentice Training; Shortage of Labor; the Foreman of the Present and Future; Thrift Plans; Relations of Employment Office and Foremen; What Management Wants; and What the Workingman Wants. George D. Halsey, employment manager of the Cincinnati Milling Machine Co., Cincinnati, was chairman of the discussion on employment office methods. M. C. Turpin, assistant manager of the publicity department of the Westinghouse Electric & Mfg. Co., East Pittsburgh, was chairman of the discussion on plant papers. Roger Babson, president of the Babson's Statistical Organization, Wellesley Hills, Massachusetts, had charge of the discussion on wage levels. Franklin T. Jones, assistant employment supervisor of the Warner & Swasey Co., Cleveland, led the discussion on apprentice training. E. J. Cole, superintendent of the Acheson Graphite Co., Niagara Falls, was chairman of the discussion on the relations of employment office and foremen. Representatives from a wide variety of industries took part in the program.

Book Reviews

Mechanical World Year Book for 1920. Pp. 328. Ill., index. Emmott & Co., Manchester, England.

The present edition of this useful handbook has been enlarged and revised, the greatest additions being in the divisions on water and hydraulic work and on heating and evaporating liquids. Other important additions are to the division on compressed air and to the screw-thread tables. While the book is not so complete as many of the American handbooks, the material included is well selected. Naturally the book is suited more to the needs of the British than the American engineer.

Manufacture and Uses of Alloy Steels. By Henry D. Hibbard. Pp. 92. Index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, $1.25.

This is a reprint of a monograph recently issued by the U. S. Bureau of Mines. After a general introductory chapter, the author considers in succession the principal kinds of alloy-steels, and gives a brief summary of the methods of manufacture, characteristic properties, and principal uses of each one, accompanied by a bibliography. While the treatment is so brief that occasional omissions of important facts are inevitable, the book should prove of value to anyone interested in the subject.

Metallography. Part I. Principles of Metallography. By Samuel L. Hoyt. Pp. 251, ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, $3.

This book is one of a series of three, the other two of which are in preparation, and which will deal with the Metals and Common Alloys, and with Technical Practice. The first chapter of the present volume explains the use of constitution diagrams, from such a simple form as the one showing graphically the solid, liquid, or gaseous condition of water as a function of pressure and temperature to the more complicated diagrams showing certain properties of a ternary alloy, such as the copper-tin-zinc series. The next chapter discusses the preparation of metallic alloys in the laboratory, particularly the method of fusion in a crucible. Then come chapters on microscopy and on the microstructure of metals and alloys. The next chapter considers pyrometry and thermal analysis, including the determina-

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tion of melting points and critical points. The concluding chapters are devoted to the physical and mechanical properties of metals and alloys. The book will be of value to the blast-furnace man, to the steel-mill operator, to the foundryman, and to the metal-worker in general.

The Organization of Industrial Scientific Research. By C. E. Kenneth Mees. Pp. 167, ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, $2.

Few of us not directly connected with work of this character realize either the number of men engaged and the amount of money invested or its importance in relation to industry. The author of this book is director of the research laboratory of the Eastman Kodak Co., and is therefore qualified to speak with authority upon his subject. The author classifies the principal types of research laboratories as follows: those maintained by universities; by government agencies; by 'foundations'; by individual firms; by cooperation between firms, usually within a given industry; under industrial fellowships; and by private consultants. The advantages and disadvantages of each type are discussed, as well as the field of research for which it is best suited. Then comes a discussion of the organization, staff, building, and equipment required for a laboratory. The final chapter considers the design of a research laboratory for a specific industry. There is also a bibliography. The book is so clearly written and deals with such an interesting subject that almost any person of intelligence would enjoy reading it, while it will be indispensable to any individual or firm considering the establishment of a laboratory.

Trade Notes

The Commercial Acetylene Co. is building a concrete factory at Slauson and Boyle avenues, Los Angeles.

The Skandia Pacific Oil Engine Co. is offering $300,000 worth of one to three year first-mortgage certificates.

The Llewellyn Iron Works is building a new steel-frame foundry at its plant on North Main street, Los Angeles.

The Western Machine & Foundry Co., of Santa Barbara, will increase its capital stock from $50,000 to $200,000.

The Vegetable Oil Products Co. will spend $300,000 on a station at Wilmington, in the Los Angeles harbor district.

The Atchison, Topeka & Santa Fe Railroad will construct an ice-plant with a capacity of 1000 tons per day at Riverbank.

R. C. Gosrow has opened offices in the Spreckels building as a consulting engineer specializing in electro-metallurgical work.

The General Chemical Co., of New York, will construct a $2,000,000 sulphuric-acid factory at El Segundo, Los Angeles county.

The California Peanut Co. will build a three-story concrete factory-building on 20th street near San Pablo avenue, Oakland. The estimated cost is $75,000.

The Southern Pacific Co. will build a new boiler-house, blacksmith shop, foundry, paint-shop, and carpenter-shop at South San Francisco.

The Bristol Co. has issued Catalogue No. 1101, describing the various types of recording thermometers and accessories manufactured by the company.

F. W. Sinram, president of the **Van Dorn & Dutton Co.**, of Cleveland, has been re-elected president of the American Gear Manufacturers' Association.

The Oregon, Washington and Idaho Aeroplane Co., of Portland, is erecting a hangar and repair-shop at Guilds Lake at an estimated cost of $10,000.

The Southern Pacific Co. will build a new brass-foundry and a spring-factory at its Sacramento shops. The estimated cost is $400,000.

The second annual convention and exhibit of the **American Steel Treaters' Society** will be held at the Commercial Museum, Philadelphia, September 14 to 18.

The Silverton Blow Pipe Co., of Silverton, Oregon, is building a complete new foundry including a mono-rail overhead-carrier system, at a total cost of $15,000.

Work has been commenced on the factory of the **Pacific Car Building Co.** at Woodland. The company claims to have $1,000,000 worth of work under contract.

The Everett Steel Co., of Everett, Washington, makers of iron and steel castings, has bought property near its plant, which will be used later for making extensions.

The C. L. Best Gas Traction Co. is offering $1,250,000 worth of preferred stock, the proceeds to be used in increasing the facilities at its San Leandro plant.

The Pasadena Foundry Co. has filed notice of organization to manufacture iron and other castings. John M. Miller, 145 Gertrude court, Pasadena, is president.

Arthur D. Little, Inc., chemists and engineers, of Cambridge, Massachusetts, have issued a complete bibliography on 'The Electric Furnace as Applied to Metallurgy'.

The C. E. Hill Co., of Oakland, has been incorporated with a capital of $10,000 by C. E. Hill, C. E. S. Hill, and A. H. Jordan to manufacture dairy machinery and supplies.

John B. Matthews, formerly consulting engineer for the Moore Shipbuilding Co., has opened offices as a consulting engineer and marine surveyor at 16 California street.

The Holt Manufacturing Co. entertained the employees at its Stockton plant and their families at Oak Park on May 22, the occasion being the annual picnic of the company.

The first of the five sections of the floating drydock formerly at the **Skinner & Eddy** company yards at Seattle reached the **Moore Shipbuilding Co.** yard on the Oakland estuary on May 7.

The American Bridge Co. has been awarded the contract for furnishing about $200,000 worth of structural steel for the building for the San Francisco branch of the Federal Reserve Bank.

Albers Bros. Milling Co. has bought a brick warehouse at G and Mariposa streets, Fresno, and will remodel it. A flour-mill costing $250,000 will be built on a site adjoining the warehouse.

Holbrook, Merrill & Stetson have let a contract for a reinforced concrete addition to their plant in San Francisco. The building will be 137 by 275 ft. and will cost approximately $500,000.

James Reed, formerly of the construction corps of the U. S. Navy, with the rank of commander, has been appointed assistant general manager for the **Los Angeles Shipbuilding & Drydock Company.**

Tartar & Webster, shook manufacturers of Stockton, will build a box factory at Dorris. The Dorris Lumber & Box Co. has recently completed the installation of electrical machinery at its plant.

The Eastern Oregon Light & Power Co. will build a steam-plant at La Grande at a cost of approximately $200,000. It has also purchased machinery for improvement of the gas-plant at Baker.

The Griffin Wheel Co., of South Tacoma, is doubling the capacity of its plant. The new building will adjoin the present factory and will be seven stories high. The estimated cost is $100,000.

The Mars Manufacturing Co., manufacturing the Mars truck-attachment, has moved its plant and offices from

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Seattle to Yakima. A 100 by 140-ft. one-story brick building has been constructed.

The Central Brass Foundry Co., 1055 East 40th street, Los Angeles, has filed notice of organization to brass and bronze products. Charles Francis, 1039 East 42nd street, Los Angeles, is president.

On account of increasing business in the fabrication of structural steel for motor-truck frames and miscellaneous purposes, **Sims & Gray**, 156 Main street, are considering installing additional equipment.

Contract for repairing the Northwestern Pacific Co. ferryboat 'Sausalito' has been awarded to the **Moore Shipbuilding Co.** The walking-beam of the boat broke while in service. The repairs will cost about $60,000.

The Power Construction Co. of San Francisco has secured a 2½-acre site between the Pacific Coast Steel Co.'s mill and the Virden Packing Co.'s plant at South San Francisco and will build a shop for fabricating structural steel.

The wooden shipbuilding plant of the **G. M. Standifer Corporation** and the mill of the **North Portland Box Co.** at Kenton near Portland were completely destroyed by fire on May 24. The loss is estimated at $1,000,000.

The Pacific Iron Co. has been organized with a capitalization of $1,000,000 by J. Boyd Oliver, Charles McLaughlin, C. O. Greever, and H. R. Sherry, all of San Francisco. The company will manufacture iron and steel products.

Frank B. Drake, president of the Johnson Gear Co., and **W. E. Creed**, president of the Columbia Steel Co., have been elected directors of the San Francisco Chamber of Commerce for the coming year. There are 21 directors in all.

The Atchison, Topeka & Santa Fe Railroad will spend $1,000,000 enlarging its shops at Albuquerque. When this work is completed, the Albuquerque shops will be next in size to those at Topeka, the largest on the company's system.

Edward F. Buie, formerly with the Union Hardware & Metal Co., of Los Angeles, has recently been appointed Pacific Coast representative for the **Victor Saw Works, Inc.**, of Springfield, Massachusetts, succeeding Victor Pezzini, resigned.

The Simmons Co., manufacturing brass bedsteads, has bought a lot 97 by 160 ft. at the south-east corner of Powell and Bay streets, on which will be erected a three-story reinforced concrete administration-building to cost about $80,000.

L. T. Pockman has been appointed district manager for the **Chicago Pneumatic Tool Co.** at Los Angeles, with headquarters at 307 East Third St. Mr. Pockman is well and favorably known to the metal trades in the West and his appointment will be of interest to many.

The California Industries Association, which is the new name for the Home Industry League, has elected the following officers for the coming year: president, Frank D. Fagan; vice-presidents, R. D. Quinlan and J. H. McDonough; secretary, C. W. Helser; manager, N. H. Sloane.

After considerable discussion of sites on both sides of the Sacramento river, the directors of the **Virden Packing Co.** have finally decided to build their new plant on the site originally selected at West Sacramento. Work will be commenced soon. The estimated cost is $1,500,000.

The plant of the **Illinois Pacific Glass Co.**, at 15th and Folsom streets, was almost completely destroyed by fire on May 23. The company's machine-tool equipment, which was as fine as that of any concern on the Coast, was reduced to scrap. The total loss is estimated at $1,000,000.

The Golden West Manufacturing Co. has been incorporated with a capital of $50,000 by J. G. Lyons and E. M. Hansley, of Stockton, and D. D. Schneider, of Victor. The company will build a factory at Stockton to manufacture various specialties, such as a flour-sifter, a deflector for electric fans, and a boltless rail-joint.

The R. & J. Dick Co., Inc., of Glasgow, Scotland, whose Pacific Coast branch has been at Seattle for the past five years, has moved its headquarters to 557 Mission street, San Francisco. The concern is one of the largest in Scotland, manufacturing 'Dickbelt' shafting and similar products.

R. W. Reid, of the **Taft-Pierce Manufacturing Co.**, Woonsocket, Rhode Island, was in San Francisco for several days last month. **Louis G. Henes**, 75 Fremont street, has arranged to handle the Taft-Pierce line, which includes magnetic chucks, gauges, and inspection tools, in this district.

The Armstrong-Watson Co., Inc., manufacturing the Campbell rotary pump, has bought an acre of land at East Adams street and Long Beach avenue, Los Angeles. There are three buildings now on the property, one of which will be used for a machine-shop. H. I. Armstrong is president of the company.

Construction of the factory of the **National Axle Co.** at San Jose has commenced and the concern will probably be on a producing basis by September 1. The corporation has placed $130,000 worth of orders for machine-tools. A number of lathes have been purchased from the **Axelson Machine Co.**, of Los Angeles.

The Edison Electric Appliance Co., Inc., will make extensive improvements at its plant at Ontario, California. All the corrugated-iron buildings are to be replaced with concrete, and several new buildings are to be erected. The total cost is estimated at $250,000, $190,000 of which is to be spent during this year.

Van. H. Manning, formerly director of the U. S. Bureau of Mines, has resigned. He has been succeeded by **F. G. Cottrell.** Mr. Cottrell is best known as the in inventor of the Cottrell process for the electrical precipitation of fume and fine particles suspended in the gases of smelter, blast-furnace, and cement plants.

A. O. Gates, sales engineer for the **Dodge Sales & Engineering Co.**, has come to San Francisco to make his headquarters here. He will devote his attention principally to mining and metallurgical equipment and expects to make a trip through Arizona, New Mexico, and Colorado, soon. His office is at 1407 Hobart building.

Grant-Smith & Co., of Portland, were the only bidders for construction of the Cedar River pipe-line No. 3 from Molasses creek to Volunteer park, Seattle, which is to be of steel pipe 78 in. diam. and will be approximately 16 miles long. The company's bids ranged from $3,311,764.20 to $3,601,025.75, according to the thickness of the pipe.

The National Engineering & Drydock Corporation has filed articles of incorporation. The company is to build and repair ships and to engage in a general engineering business. The directors are George W. Ley, Max L. Gordan, and Abe Raffee, all of Los Angeles, and Roy Atkinson of Santa Monica. The authorized capital is $500,000.

Smelting furnaces are among the many products of the **Worthington Pump & Machinery Corporation.** Bulletin 'P. M. 55' describes blast-furnaces, reverberatory furnaces, water-jackets, forehearths, and other accessories of both lead and copper smelters. Various types and sizes of equipment are supplied by the Worthington company.

The United States Marine Equipment Co. has been organized with a capitalization of $500,000 by W. J. Milne, Frank J. Super, W. H. Blevens, and S. E. Tromley. Offices will be maintained at Portland and a factory erected either at Portland or at Astoria. The principal article to be manufactured will be the Super davit, a patented device for lowering lifeboats from a ship.

The drydock under construction for the **Ames Shipbuild-**

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ing & Dry Dock Co. at its yard at Seattle has been sold to the **Bethlehem Shipbuilding Corporation,** and will soon be towed to the Alameda yard of the Bethlehem company. Two units of the dock have already been completed and the third is under construction. The Ames company will build another dock for its own use.

The Portland Vegetable Oil Mills Co. has been incorporated by C. A. Edwards, S. L. Eddy, and P. W. Cookingham, all of Portland. The authorized capital is $1,000,000, about half of which has already been subscribed. The company will construct a reinforced concrete vegetal-oil mill at Linnton, near Portland, at an estimated cost of $250,000 for buildings and $200,000 for machinery.

DeWitt V. D. Reiley, formerly vice-president of the **Davis-Bournonville Co.,** has been elected president of the company, succeeding **Augustine Davis,** who resigned last November. **Charles B. Wortham,** treasurer of the company since its organization, was elected vice-president, and **William G. McCune,** secretary and treasurer. The directors are **DeWitt V. D. Reiley, Charles B. Wortham, William G. McCune, Augustine Davis, Charles J. Mayer, Daniel E. Evarts,** and **H. Rowntree.**

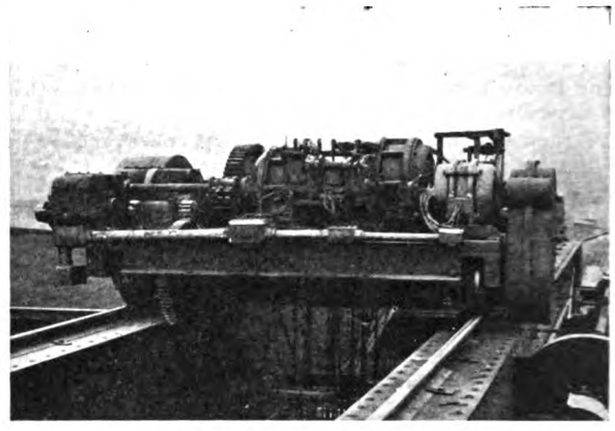
The Bridgeport Brass Co. has published a handsomely illustrated 80-page booklet 'Seven Centuries of Brass-Making', which traces the development of brass-foundry practice, discusses the reasons why the company abandoned the use of crucibles and adopted the electric furnace in its work, discusses the technology of modern brass-making, and describes the methods of manufacture of the company's products, which include tubing, sheets, rods, wire, and miscellaneous articles of brass.

C. H. Rippon, employed in the **Southern Pacific Co.'s** general shop at Sacramento, has carried off 'top honors' for the fourth successive year in the annual competition among 50,000 employees to further safety work on the Pacific system. His duties as an estimator and piece-work inspector enable him to watch not alone for any unsafe methods in shop practice, but also to suggest ways and means for furthering safety in all lines of railroad equipment. **C. E. Blair** and **W. E. Thomas,** also of the Sacramento shops, received second and third honors, respectively.

A heat of 24,068 lb. was recently poured at the Puget Sound Navy Yard, Bremerton, Washington, from a 6-ton **Greaves-Etchells** furnace similar to the one described in 'Metal Trades' for April. Three blows of converter steel were added to the 12 tons of electric steel and a large stern-frame casting was successfully poured. The final anaysis of the electric steel was: carbon, 0.19%; manganese, 0.56%; silicon, 0.20%; phosphorus, 0.025%; sulphur, 0.026%. The scrap from which this was made contained 0.068% phosphorus and 0.05% sulphur. In addition to making good large castings the operators at Puget Sound have been successful in producing small steel high-pressure globe and angle valves.

Among the men representing the metal industries of the Pacific Coast at the recent Foreign Trade Convention in San Francisco were **William Pigott, J. D. Fenstermacher, P. R. Thompson, J. C. Axelson, B. C. Ball, Andrew Carrigan, H. O. Stevens, Carl Schulz, A. H. Kellogg,** and **A. J. Richie.** Western representatives of Eastern concerns included **A. T. DeForest, B. H. Tripp, W. A. Taylor, J. K. Barker, William Best, Jr., C. P. Hensley, J. W. Judge, E. W. Kratzer, J. A. Kinkead,** and **H. E. Stuard.** Some of the Eastern men who attended the convention were **James A. Farrell, Eugene P. Thomas, C. B. McElhany, W. L. Saunders, Robert Radford, Roy G. Owens, C. A. Richards, A. I. Findley, W. O. Vilter, T. C. Ham, J. F. Welborn, D. J. Champion, J. C. Watson,** and **F. S. Slocum.**

The crane equipment of the new **McKay Foundry** was furnished by the **Vulcan Iron Works** of San Francisco. The accompanying illustration shows the carriage on the 30-ton crane serving the main bay. The span of this crane is 50 ft. The capacity of the main hoist is 30 tons, and it has a lifting-speed of 10 ft. per minute. It is equipped with a 30-hp. motor. The auxiliary hoist has a 15-hp. motor, a capacity of 5 tons, and a lifting-speed of 30 ft. per minute. The trolley motor is 7½ hp. and has a traveling speed of 100 ft. per minute. The speed of the bridge is 300 ft. per minute. It has a 30-hp. motor. Both hoists have a 30-ft. lift. This crane is of the enclosed type with all gears and running parts protected from dirt and exposure. Such an arrangement also makes for safety. One of the features of the crane is the General Electric Co. solenoid alternating-current regenerative brake, which makes mechanical braking unnecessary. Vulcan cranes have recently been built for the Moore Shipbuilding Co.'s brass foundry, the Best Steel Casting Co., the Fageol Motors Co., and Gunn, Carle & Co. Two more cranes are now being built for the McKay Foundry.



Vulcan Crane at McKay Foundry

Market Review

While the worst of the railroad strike is over, its bad effects are still with us, and seem likely to remain for a considerable time. Its effects are cumulative, getting worse at every successive step. The blast-furnace cannot get fuel, the steel-mill and foundry cannot get either fuel or pig-iron, the manufacturing plant cannot get fuel, pig-iron, castings, or steel products, and so it goes all along the line. This general unsettlement of industry has, however, had a hand in causing a reduction in demand, so that prices are as a rule unchanged or even slightly lower as compared with last month. Foundry-iron is being sold around $43 at the furnace. Coke is unsettled, prices ranging from $11 to $13 at the furnace, and likely to change again as a result of prospective wage revisions. The local warehouse price on steel remains unchanged at $5.75 per 100 pounds.

Obituary

John Hendy, president of the Joshua Hendy Iron Works of Sunnyvale and San Francisco, died on May 12 at his home at Sunnyvale. He was the nephew of Joshua Hendy, the pioneer ironworker, who, in the early 'fifties, founded the conceern that bears his name. The original plant was at Mission and Fremont streets. Later it was moved to the North Beach district. After this building was destroyed in the fire of 1906, the plant was moved to its present site at Sunnyvale, about thirty miles south-east of San Francisco.

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